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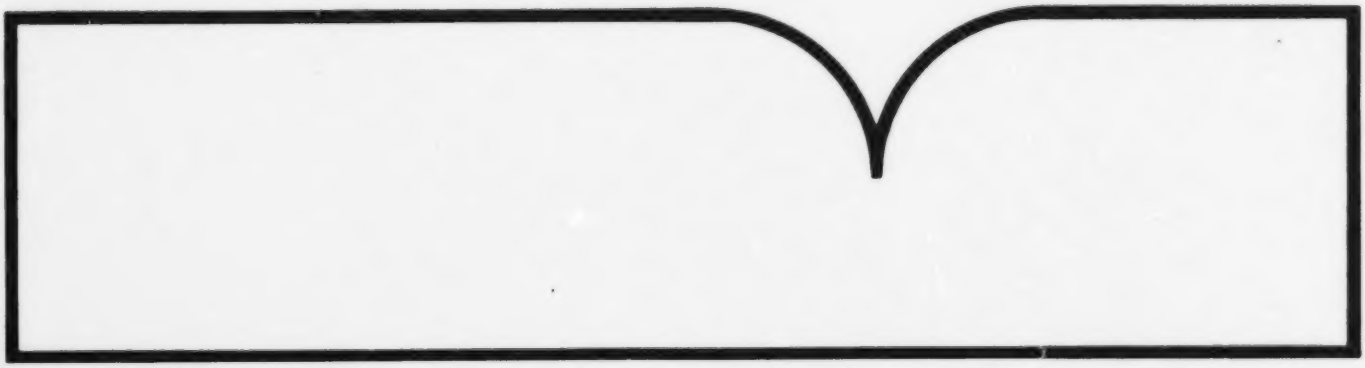
Noise Reduction Retrofit for a "New Look" Flxible Transit Bus: Service Bulletin

Tri-County Metropolitan Transportation
District of Oregon, Portland

Prepared for

Transportation Systems Center
Cambridge, MA

Sep 80



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16. Abstract

This document presents instructions on how to apply a noise treatment to a contemporary city transit bus without extensive structural alteration. Baseline bus configuration, noise ratings, and performance benchmarks are presented for a Flxible 111DC-D061 transit bus powered by a Detroit Diesel 8V-71N engine. The concepts and much of the hardware described in this report are transferable to similar buses. The information presented herein is of interest primarily to transit bus operators wanting to reduce noise by practical means, and to government agencies, manufacturers, and planners concerned with reducing the noise of buses in service at a moderate cost.

In this report instructions are given on how to retrofit the engine with a turbocharger and ancilliary hardware. Acoustic benefits and performance side-effects are given. One beneficial side-effect, because of turbocharging, is reduced harmful exhaust emissions. Another, because of smaller injectors and reduced exhaust back pressure, is fuel conservation. The instructions in this report are complete with sources for manufactured components and raw materials, and with mechanical drawings for components to be locally fabricated. Illustrations and text direct installation as well as effects of noise ratings and performance side-effects are also presented. In this report practical application is coupled with theoretical explanation throughout.

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NOISE REDUCTION RETROFIT FOR A "NEW LOOK" FLXIBLE ® TRANSIT BUS
Service Bulletin

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DISTRICT OF OREGON
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PREFACE

This document is an instruction: how to apply a noise treatment to a contemporary city transit bus without extensive structural alteration. Specifically addressed is the Flxible® Model 111DC-D061 with a Detroit Diesel 8V-71N engine; however, the concepts and much of the hardware described here are transferable to similar buses.

The information is of interest primarily to transit bus operators wanting to reduce noise by practical means, and to government agencies, manufacturers, and planners concerned with reducing the noise of buses in service at a moderate cost.

Acoustic benefits and performance side-effects are given. One beneficial side-effect (because of turbocharging) is reduced harmful exhaust emissions. Another, because of smaller injectors and reduced exhaust back pressure, is fuel conservation.

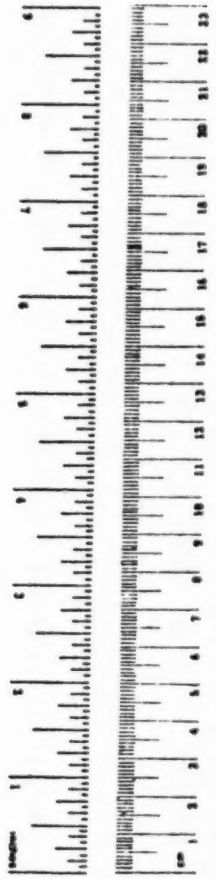
Acknowledgment is made of the special contributions made by Gary Brentano and Richard Woods of the Tri-County Metropolitan Transportation District of Oregon (Tri-Met) who managed the project.

The work has been directed by the U.S. Department of Transportation: James Campbell for the Urban Mass Transportation Administration and Robert L. Mason for the Transportation Systems Center.

METRIC CONVERSION FACTORS

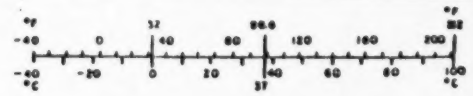
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
	inches	2.5	centimeters	
	feet	30	centimeters	
	yards	0.9	meters	
	miles	1.6	kilometers	
		AREA		
	square inches	6.5	square centimeters	
	square feet	0.09	square meters	
	square yards	0.8	square meters	
	square miles	2.6	square kilometers	
	acres	0.4	hectares	
		MASS (weight)		
	ounces	28	grams	
	pounds	0.45	kilograms	
	short tons (2000 lb)	0.9	tonnes	
		VOLUME		
	teaspoons	5	milliliters	
	tablespoons	15	milliliters	
	fluid ounces	30	milliliters	
	cups	0.24	liters	
	pints	0.47	liters	
	quarts	0.95	liters	
	gallons	3.8	liters	
	cubic feet	0.03	cubic meters	
	cubic yards	0.76	cubic meters	
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
	millimeters	0.04	inches	
	centimeters	0.4	inches	
	meters	3.3	feet	
	meters	1.1	yards	
	kilometers	0.6	miles	
		AREA		
	square centimeters	0.16	square inches	
	square meters	1.2	square yards	
	square kilometers	0.4	square miles	
	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
	grams	0.035	ounces	
	kilograms	2.2	pounds	
	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
	milliliters	0.03	fluid ounces	
	liters	2.1	pints	
	liters	1.06	quarts	
	liters	0.26	gallons	
	cubic meters	35	cubic feet	
	cubic meters	1.3	cubic yards	
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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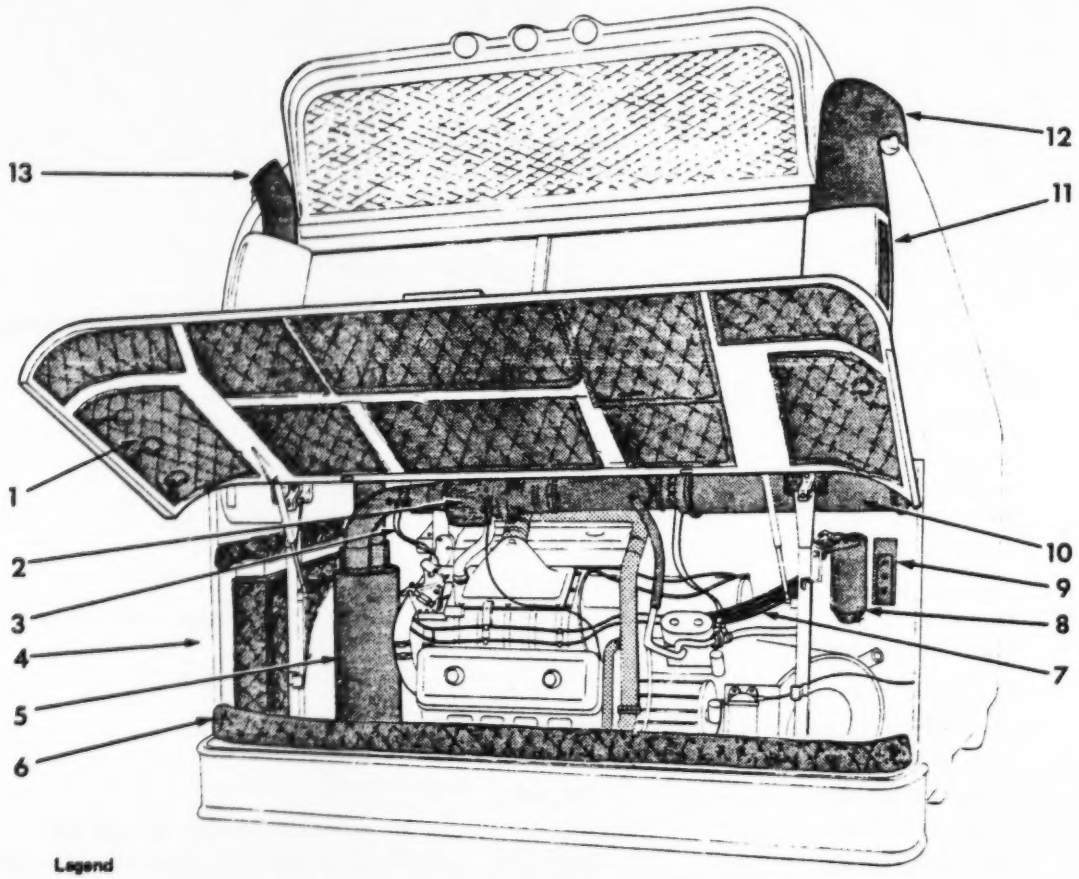
INTRODUCTION

Owing to the general rise in prices for new vehicles, an operator might choose to extend the life of existing buses by renovation and remodeling instead of purchasing modern replacements. Noise treatments might well be included in such a program. Since fleets ordinarily consist of look-alikes having many small differences, this Instruction is designed to be of greatest utility by thoroughly documenting one good way to treat a typical bus. Highlights of the treatment are depicted in Figure 1. With this information, an experienced person can adapt the treatment to other bus models and expect similar results.

This approach unavoidably entails being specific about one set of suppliers and tradenames. There are a number of other products of equivalent quality and effectiveness. Regrettably, they cannot all be mentioned.



Legend

1 Engine compartment padding
2 Jacketed turbocharger
3 Air dryer line
4 Enlarged grille
5 Jacketed muffler, relocated
6 Door stop
7 Relocated fuel lines
8 Relocated fuel filters, removed bypass oil filter
9 Relocated switch box
10 Larger air cleaner
11 Blanked inlet
12 Snorkle
13 5" exhaust stack

FIGURE 1
NOISE TREATED BUS

This, then, is an instruction for applying a noise treatment to a Flxible® Model 111DC-D061 contemporary transit bus powered by a Detroit Diesel 8V-71N engine. Basically, the engine is retrofitted with a turbocharger, requiring new intake and exhaust systems, and the engine compartment is lined with anti-noise padding. There are no major structural alterations or seriously adverse side-effects. The intent is to make these changes when the engine is due for an overhaul and will be dismounted.

BASELINE CONFIGURATION

The engineering work that led to this Instruction was done by Tri-Met in Portland, Oregon. Table 1 lists the important characteristics of the bus before it was modified.

TABLE 1.

BASELINE BUS CHARACTERISTICS

Coach Make	Flxible
Coach Model	111DC-D061
Built	October, 1972
Engine Make	Detroit Diesel 8V-71N
Engine Model	7087-4523 City transit type 43° layover clockwise rotation as viewed from flywheel
Injectors	71C5
Fuel	#1 Diesel
Transmission	Allison VS2-8
Length	35' 8"
Width	102"
Seats	42
Weight	22,560 lbs.
Axle Ratio	6 1/7 : 1
Tires	Firestone 12.5 x 22.5 bias ply, 100 psi.
Air Conditioner	Roof-mounted condenser
Exhaust System	4" tubing with EIP Aspirator
Muffler	Nelson T-120323-F
Air Cleaner	Donaldson EBA 13-0026
Pre-separator	Donaldson PVH 000885
Fan	Schwitzer L71 911024 (28" dia, 8-blades)
Radiator Core	1,048 in^2, 11 fins/inch, 222 tubes in 4 rows
Shroud	30" dia, sheet metal
Fan Drive	GMC Torus
Engine Speed at Stall	1,250 rpm
1st Upshift Engine Speed	1,800 rpm at full throttle
1st Upshift Road Speed	22 mph

PRELIMINARY FIXES

Tri-Met's buses are relatively quiet to begin with when compared to those of many other transit systems. Other operators may be able to bring their bus noise down by doing what Tri-Met has already done and by paying attention to critical repair items.

1. Derate the engine by using the *smallest available injectors:* 71C5 (equivalent to 50 mm). This will reduce full throttle engine and exhaust noise. It is not practical to reduce noise by downsetting the overspeed governor. The transmission automatically upshifts before the engine speed exceeds 1,800 rpm. Downsets to lesser speeds would overly inhibit the bus's performance. Tri-Met uses small injectors and #1 Diesel to reduce exhaust smoke. Diesel #1 can slightly reduce full throttle engine and exhaust noise since it has about 4% less heat value per gallon.

2. Have a *modulated speed fan drive* such as the standard GMC Torus hydraulic clutch or the Schwitzer Viscous clutch. This minimizes average fan noise. An on-off fan clutch is not as satisfactory, but is better than a fixed drive. Tri-Met uses automatic fan drives for improved fuel economy.

3. Prevent unnecessary exhaust noise by making sure there are no *exhaust leaks* between the engine and the muffler outlet and that the *muffler is adequate.* Joints frequently break open because there is extensive stress caused by intermotion between the engine and the muffler. Provide an intermediate flexible tube section to relieve stress.

4. Keep the air side of the *radiator core clean.* Make sure the lower part of the *fan shroud is not left off.* Keep the *fan centered in the shroud.* These items minimize average fan speed, and thus fan noise, where there is an automatic fan drive. Also, the parasitic fan load on the engine is lessened, releasing more power to the wheels and reducing fuel consumption.

5. Adjust the transmission first *upshift speed to the low end* of its range: 22 mph. This reduces peak overall noise.

6. Keep *bellypans* in place. To reduce maintenance cost, Tri-Met does not use these optional engine compartment floors. However, operators who choose to use them can expect reduced engine noise generally and reduced fan noise on the right side. Although louvered sheet metal bellypans are not as acoustically effective as they could be, they are of some benefit.

7. Replace the 3 sets of synthetic *rubber engine mounts* when they fail, especially the donut-shaped mounts where the engine cradle connects to the chassis. If this is not done, engine vibration will telegraph more strongly into the bus body and the fan will move off-center in the shroud.

8. Repair *body rattles.* Keep in good working order the various handles and hold-downs to compartment doors. Tri-Met favors the spring-loaded struts that facilitate the opening and closing of the rear engine compartment door.

TURBOCHARGER CONVERSION

A turbocharger will reduce both engine noise and exhaust noise. Engine noise is reduced due to softening of the abrupt increase in the rate of cylinder pressure rise at the onset of ignition during the compression stroke. Exhaust noise is reduced since the drive turbine reflects and scatters the impinging sound waves.

The original motivation behind supercharging engines by means of an exhaust turbine (turbocharger) was to increase power output without increasing engine size. (The 8V-71TAC is rated as high as 350 hp with 75 mm injectors.) Figure 1 shows a turbocharged 8V-71 city coach engine. Turbocharging also compensates for rarified air at higher altitudes.

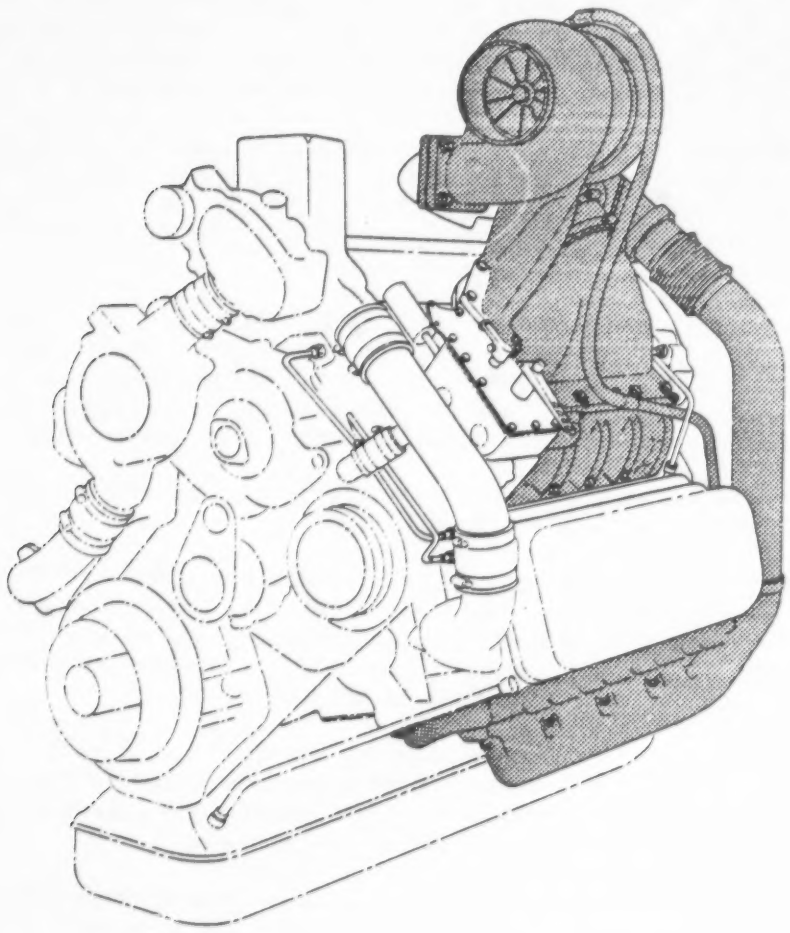


FIGURE 2.

TURBOCHARGED DETROIT DIESEL CITY COACH 8V-71

The turbocharger captures escaping energy from the exhaust pipe and returns it to the engine in the form of denser intake air. This enables more fuel to be burned and thereby more power to be produced.

The effect can be intensified with an "aftercooler" which cools the compressed intake air, making it even more dense. An aftercooler retrofit was not attempted. Making room for the aftercooler in the vee of the block requires more engine modification than it is worth.

Turbocharging reduces harmful gaseous exhaust emissions and can slightly improve fuel efficiency. Practically all diesel engines manufactured in the U.S. will be turbocharged in the future to satisfy clean air regulations.

Although turbocharging provides more air, thus allowing more fuel to be burned, it is inconsistent with noise control to increase fuel input along with a turbocharger retrofit. Consequently, injector size is kept the same or reduced if possible.

To plan a turbocharger conversion, the bus operator should review the information in Table 2 with his local engine dealer.

TABLE 2.

COMPARISON OF KEY ENGINE HARDWARE
WHEN CONVERTING AN 8V-71N INTO AN 8V-71T

Item	8V-71N	8V-71T
[1] Engine Model	7087-4523	[2] 7087-4620 Modified
[3] Compression Ratio	18.7 : 1	17 : 1
[4] Cylinder Kit	Naturally Aspirated City Coach Engine	Automotive Turbocharged with Crosshead Piston
Valves & Valve Inserts	Inconel X	[5] Nimonic 90
[6] Blower Drive Ratio	2.05 : 1	1.95 : 1
[7] Blower Seals	Lip	Ring
[8] Throttle Delay	.454"	.345"
Injectors	71C5	71C5
[8] Injector Timing	1.484"	1.496"
[9] Turbocharger	None	TV-8101 5101513 A/R 1.60
Exhaust Manifold, Crossover Pipes, and Blower Inlet	N Type	Turbo Type

Notes to Table 2

[1] These model numbers apply to a Flxible® city coach with a 43° layover.

[2] Model 7087-4620 applies to an 8V-71TAC which comes with an aftercooler. We are deleting the aftercooler. There is no model designation for a city coach 8V-71T (turbocharged without aftercooler).

[3] Compression ratio is reduced to prevent overstressing the engine since the manufacturer anticipates more fuel, more cylinder pressure (BMEP), and more power. We are not adding more fuel and taking more power, but we change the pistons anyway because their improvements, including their improved piston rings, will extend engine life.

[4] Since we do not use an aftercooler, we can use the same design N-engine cylinder liners which have shorter intake port slots.

[5] Built to withstand higher temperatures of turbocharged engines.

[6] Scavenging blower is slowed to the minimum to save parasitic power loss. The blower is still needed to purge spent gases of combustion during situations when the turbocharger is lagging and not up to speed.

[7] Improved seal needed to withstand higher air box pressures.

[8] Reducing compression ratio tends to make the engine harder to start. Compensating adjustment is made to injector timing. If hard starting is still a problem in adverse weather, an ether cup installed on the dirty side of the air cleaner is recommended. With turbocharging, there is a tendency for a puff of smoke to occur at the onset of full throttle acceleration. Adjustment of the throttle delay corrects this.

[9] Tri-Met chose the TV-7101 (A/R = 1.23) turbocharger, Part Number 510509 which is designed for the 1978 8V-71TAC "California" engine. This is a more "active" turbo. Since we wanted significant supercharging at our customary low power levels, we selected this optional model. The TV-8101 is usually supplied with an 8V-71T, but is better matched with the highway truck application where engine load is higher.

The engine should have die-cast aluminum valve covers and a block-mounted crankcase breather pad.

Table 3 lists the changes in engine operating characteristics caused by turbocharger conversion.

After the engine is reassembled and checked for proper operation, check the turbocharger's functioning by measuring the pressure in the air box while the engine is under full throttle. Rather than rely on the idiosyncrasies of a chassis dynamometer, a simple, repeatable test is to drive the bus up a steady grade at full throttle, accelerating slowly, and note the air box pressure 100 rpm before top speed is reached. Pressures up to 50 inches of mercury can be expected. This baseline reading can be used later for verification if the turbocharger's performance is suspected of having fallen off.

With turbochargers, one must guard against any exhaust gas leakage past manifold gaskets, joints, or through cracks in the exhaust system upstream from the power turbine. This will weaken their propulsion. Also, it is important not to let air cleaner filter elements load up with dirt past the allowable restriction limits.

TABLE 3.

CHANGES TO ENGINE OPERATION
DUE TO TURBOCHARGER CONVERSION
(Relevant to 2,000 rpm, full throttle, and #1 Diesel)

	Item		Units	8V-71N	8V-71T
[1]	Allowable exhaust back pressure		"Hg	6	3
[1]	Allowable intake restriction		"H_2O	25	20
[2]	Air Flow		CFM	830	1,030
[3]	Water Flow		GPM	123	123
[4]	Heat Rejection to Coolant		BTU/min	6,322	7,040
[5]	Output		BHP	218	220
[6]	Fuel Efficiency		lbs/BHP-hr	.394	.402
	Peak Torque		ft-lbs	660	740
			rpm	1,200	1,200
	Exhaust emissions	NO_2	PPM	1,150	980
		HC	PPM	153	111
		CO	PPM	140	154

[1] Sensitivity of turbocharger to aspiration restriction is reflected in more stringent limits set by the engine manufacturer.

[2] Reflects supercharging effect of turbocharger.

[3] No change to water pump.

[4] Heavier load on cooling system due to higher cylinder temperatures.

[5] Same injectors, same fuel, same horsepower at rated speed.

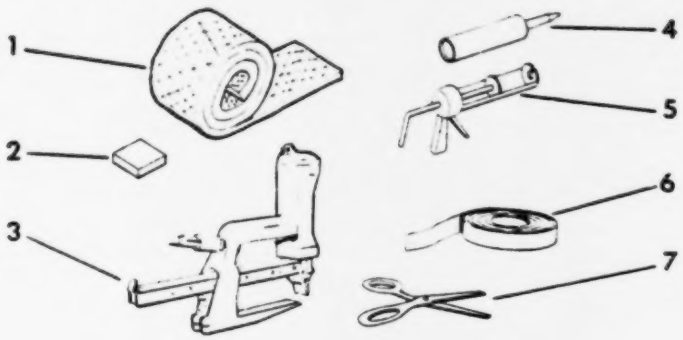
[6] No significant change to BSFC when converting an 8V-71N to an 8V-71T, but state-of-the art turbocharged diesels do have improved fuel efficiency.

ENGINE COMPARTMENT PADDING

The engine compartment is padded with a 1½ inch thick material that is soft, rugged, and easily bent. It consists of a 10 oz/ft^2 lead septum sandwiched between two blankets of glass fiber. The composite is protected by a lightweight waterproof aluminized glass cloth. The lead serves as a sound barrier and the glass fiber blankets reduce echoing. It can be steamcleaned and is incombustible.

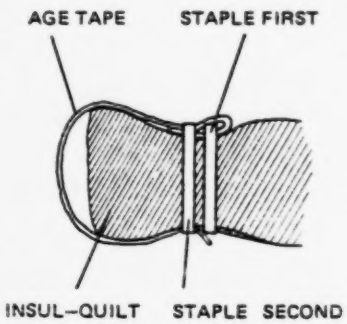
After cutting to size with ordinary hand shears (die cut in mass production), the fabricator binds the edges by stapling on an aluminized glass cloth edging tape (AGE) as shown in Figure 3. The pads can be held in place with mechanical fasteners, but we use a quick-drying adhesive especially compounded for the purpose.

STEP 1
Gather tools, materials, and cut panels to size



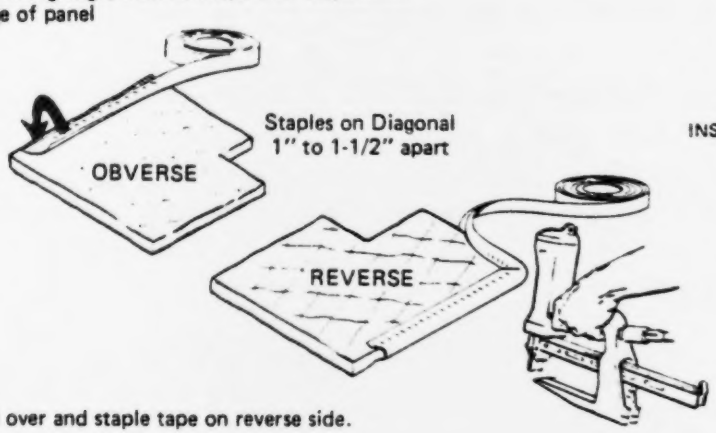
Legend

1 Insul-Quilt, type 6
2 1/2" x 5/8" Staples
3 Bostitch pneumatic stapler
4 Insul-Coustic adhesive
5 Cartridge gun
6 3" AGE tape
7 Shears



DETAIL SECTION

STEP 2
Staple tape along edge, then roll tape over staples and around edge of panel



STEP 3
Turn panel over and staple tape on reverse side.

FIGURE 3
ANTI–NOISE PADDING FABRICATION TECHNIQUE

The padding is placed on all flat areas or single curvature surfaces that are not subject to removal for routine service operations.

Figure 4 illustrates the muffler jacket. It is lined with two layers of ceramic cloth for thermal protection and held in place with ½" wide steel bands applied by the strapping apparatus ordinarily found in Shipping Departments. This jacket stops muffler shell noise, reduces echoing of fan and engine noise, and protects maintenance personnel from accidental burns.

Legend

1 10" x 15" Oval Muffler
2 Edging Taper
3 Two Layers Ceramic Cloth Lining 26" x 44"
4 26" x 44" anti-noise pad
5 1/2" Steel Strap

REFER TO DWG: SK-A-10003A

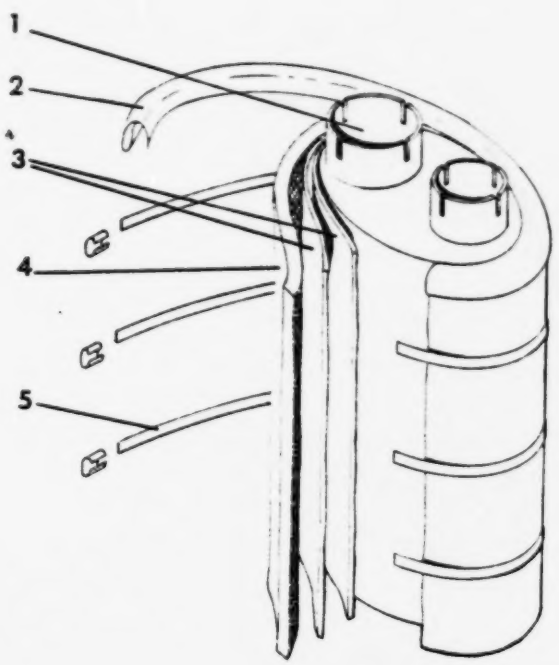
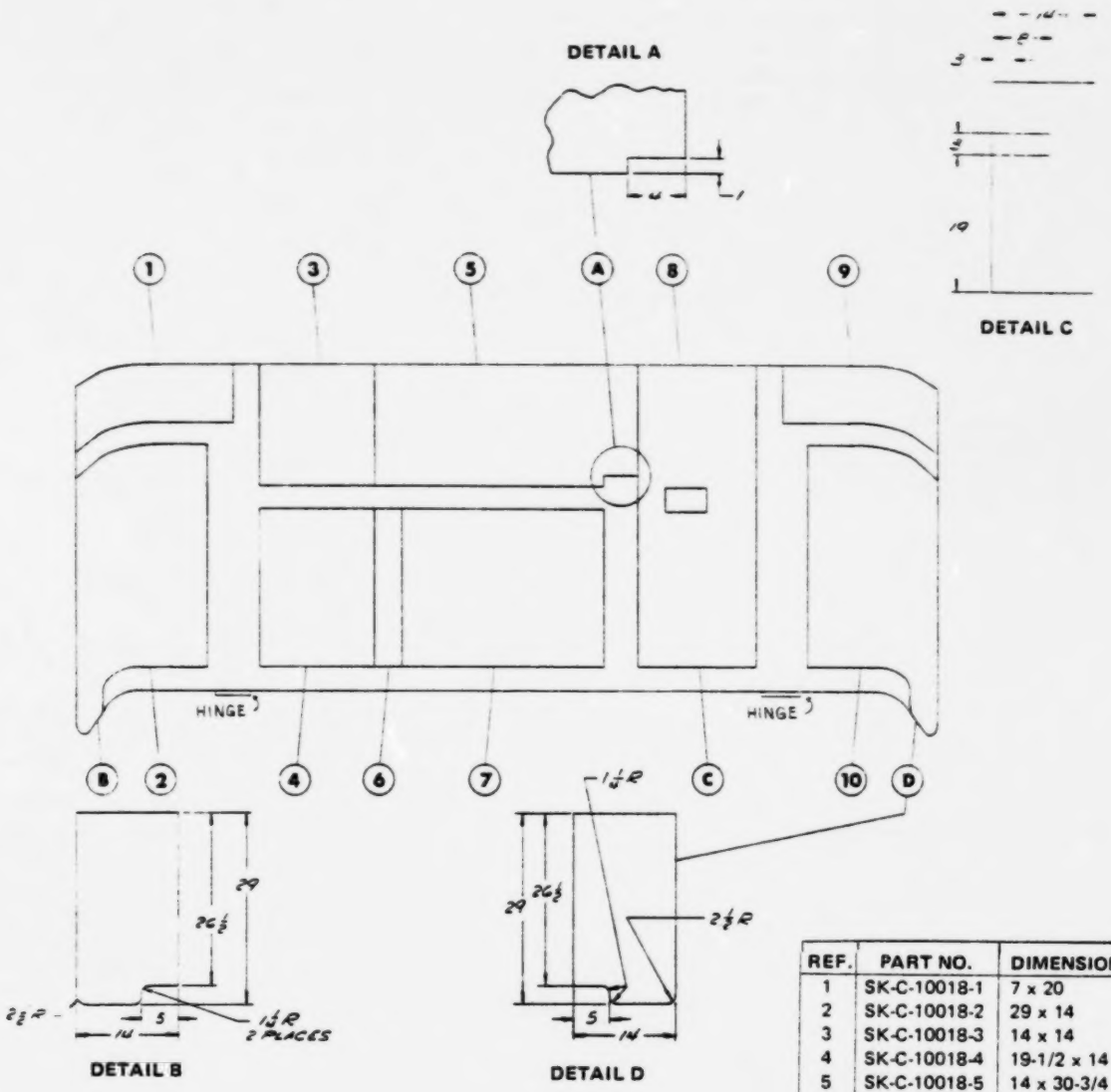


FIGURE 4.
MUFFLER JACKET

Figure 5 dimensions and locates the ten anti-noise pads that fit into the recesses of the rear door to the engine compartment. A single large pad would be simpler, but there is insufficient room between the high spots on the door and the high spots on the engine. Chafing would penetrate and harm the pad.

Before gluing pads to the door, remove lamp holders and attach crimped screw holders to the screw holes in the door. Lamps can thereafter be removed and serviced from the outer side of the door without requiring access to the nuts on the inside. Cut holes in the pads to let wiring run to lamps.

To seal the upper edge and right and left sides of the rear door, 1 3/8" OD sponge rubber tubing is split in half and glued flat side down to the niche in the door's edges.

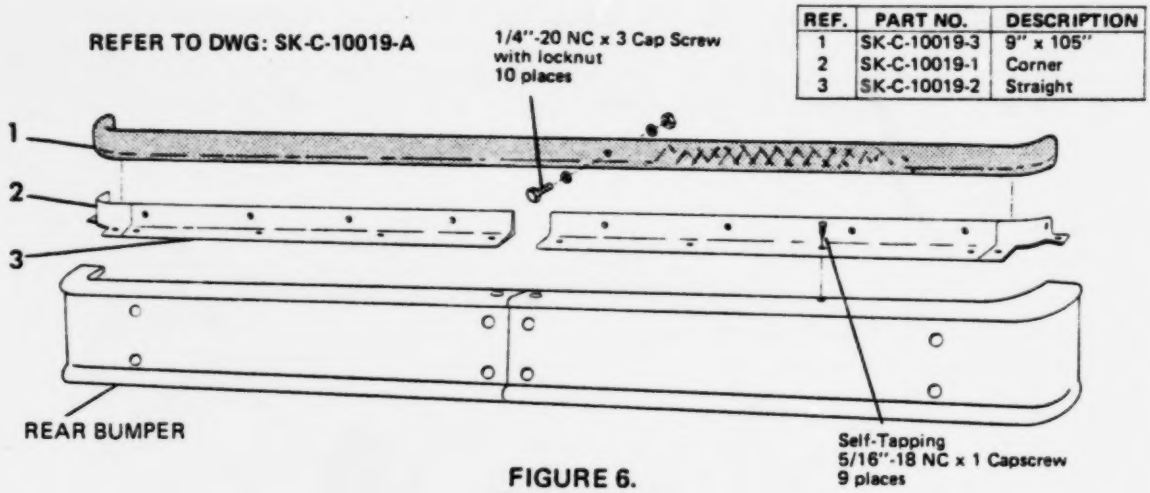


REF.	PART NO.	DIMENSIONS
1	SK-C-10018-1	7 x 20
2	SK-C-10018-2	29 x 14
3	SK-C-10018-3	14 x 14
4	SK-C-10018-4	19-1/2 x 14
5	SK-C-10018-5	14 x 30-3/4
6	SK-C-10018-6	19-1/2 x 3
7	SK-C-10018-7	19-1/2 x 24
8	SK-C-10018-8	35 x 13-1/2
9	SK-C-10018-9	7 x 20
10	SK-C-10018-10	29 x 14

REFER TO DWG: SK-C-10018-A

FIGURE 5.
REAR DOOR PADDING

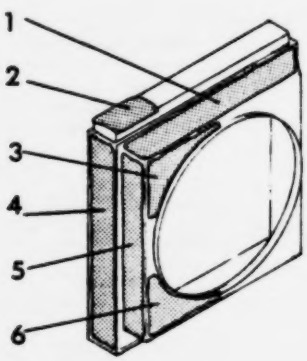
To seal the lower edge of the rear door, a door stop is fastened to the bumper so that it just touches the door padding when the door is fully closed. Figure 6 shows how an anti-noise pad is folded over a 4-piece aluminum angle, forming a seal with the door padding to reduce escaping noise.

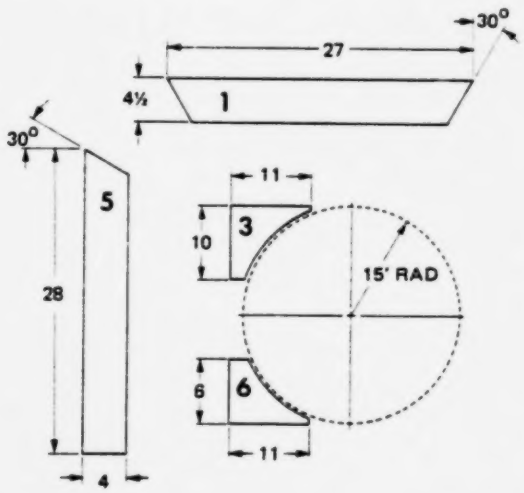


REF.	PART NO.	DESCRIPTION
1	SK-C-10019-3	9" x 105"
2	SK-C-10019-1	Corner
3	SK-C-10019-2	Straight

FIGURE 6.
DOOR STOP

Figure 7 dimensions and locates the six pads that are glued to the radiator and shroud assembly.





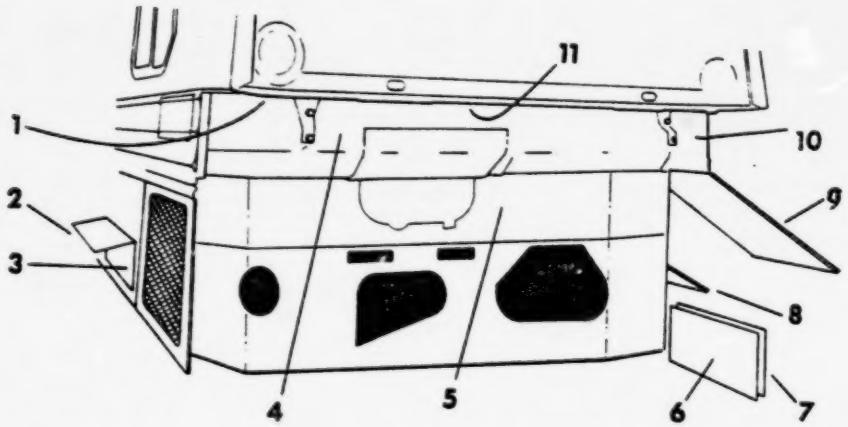
REF.	PART NO.	DIMENSIONS
1	SK-B-10022-1	4½ x 27
2	SK-B-10022-2	6 x 9
3	SK-B-10022-3	10 x 22
4	SK-B-10022-4	6 x 25
5	SK-B-10022-5	4 x 28
6	SK-B-10022-6	6 x 11

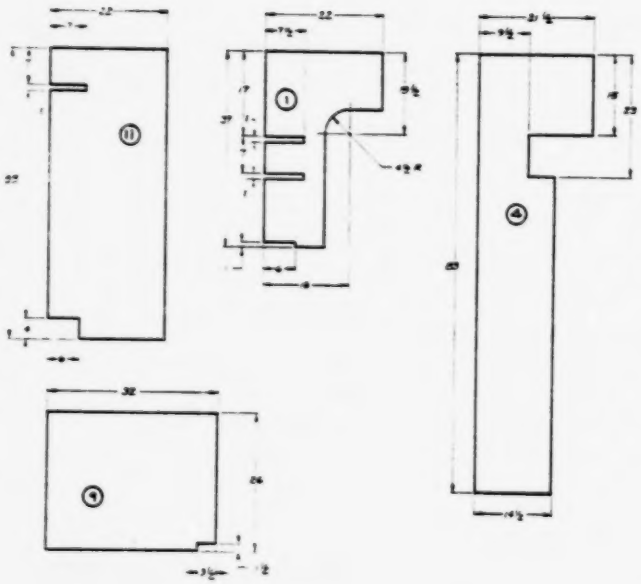
REFER TO DWG: SK-C-10022A

FIGURE 7.
RADIATOR INSUL-QUILT TREATMENT

Anti-noise pads are put on the overhead and on the firewall of the engine compartment. The numerous mounting brackets, wire harness clips, and hose clamps are detached from these surfaces and reattached over the pads. These pads are depicted on Figure 8 along with the pads that attach to the right side of the engine compartment.

Finally, anti-noise pads are installed in the air conditioner compressor compartment on the left side of the bus and in the circuit breaker compartment on the right side just ahead of the engine compartment. Both door pads are glued in place. The compressor compartment floor is simply laid down.





REF.	INSUL-QUILT PAD	DIMENSIONS
1	Overhead Left	See Detail
2	Compressor Door	13½ x 24
3	Compressor Floor	22 x 32
4	Rear Wall	See Detail
5	Firewall	14 x 63
6	Lower Right	14 x 31
7	Aluminum Backing Plate	14 x 33
8	Electrical Compt Door	13½ x 31½
9	Right Hand Door	See Detail
10	Upper Right	11 x 13
11	Overhead Right	See Detail

REFER TO DWG: SK-C-10021A

FIGURE 8.
FIREWALL, ETC. PADDING

AIR INTAKE SYSTEM

A new air intake system is installed because the turbocharger displaces the original air cleaner and because the engine both draws in more air and is more sensitive to air intake restriction (Table 3). The main changes are:

	Before	After
Air Cleaner	Donaldson EBA 13-0024	Donaldson ECG 11-2000
Pre-cleaner	Donaldson PVH 000885	Removed
Inlet	Rear window cowl	Rooftop snorkle

The turbocharger requires that the air filter element must be serviced when intake restriction reaches 20 "H_2O. If not, exhaust emissions will become unduly polluted.

The pre-cleaner is removed due to lack of space.

To compensate for the tendency toward shorter air filter service interval caused by the more demanding engine and the loss of the pre-cleaner, a larger air cleaner (80% more filter paper area) is used and the air is taken in from a cleaner source atop the bus roof facing forward.

The existing air intake system is removed and replaced with the system shown in Figure 9. The new filter element is easier to remove and replace. The rubber reducing elbow is protected from the hot exhaust pipes forming a wye before entering the turbocharger by insulating jackets covering the pipe elbows.

OIL FILTERS, ETC.

Originally, the exhaust manifolds emptied at the front of the engine into tubes that joined in a wye and led away to the muffler. After turbocharging, the exhaust manifolds empty toward the rear of the engine into tubes that sweep upward into a wye before entering the turbocharger. The left bank tube displaces the primary and secondary fuel oil filters bracketed above and behind the engine to its left.

Since there is no real need for the by-pass lubrication oil filter, it is removed. The space it occupied on the right side of the engine compartment where it was bracketed to the engine cradle hanger is now used for the fuel filters. Their new bracket, SK-B-10014, appears in its relative location in Figure 9. A new run of six hydraulic hoses connecting the fuel filters must be cut to length and installed.

The remote control engine-start switch box was originally mounted upon an angle clip in the upper right corner of the engine compartment. It is displaced by the new air cleaner location and dropped straight down to hang from the same angle clip by means of a new bracket, SK-B-10013, which also shows in its relative location in Figure 9.

The new air cleaner also displaces the small manifold which carries several oil pressure sending units, etc. Affected in the same way is the pressure switch that prevents the air conditioner compressor's drive from engaging at engine speeds above low idle. These items are moved downward on the firewall to a location below the new air cleaner.

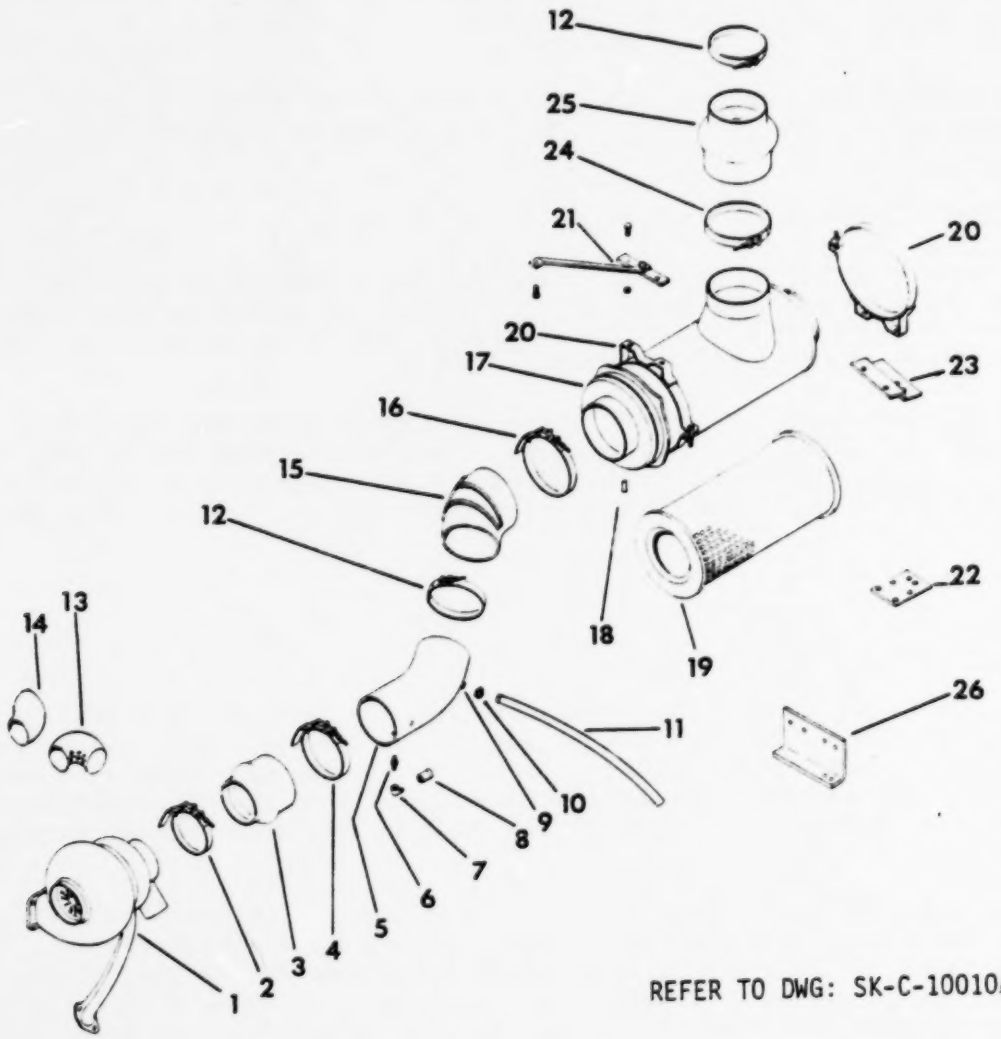


FIGURE 9.
AIR INTAKE SYSTEM

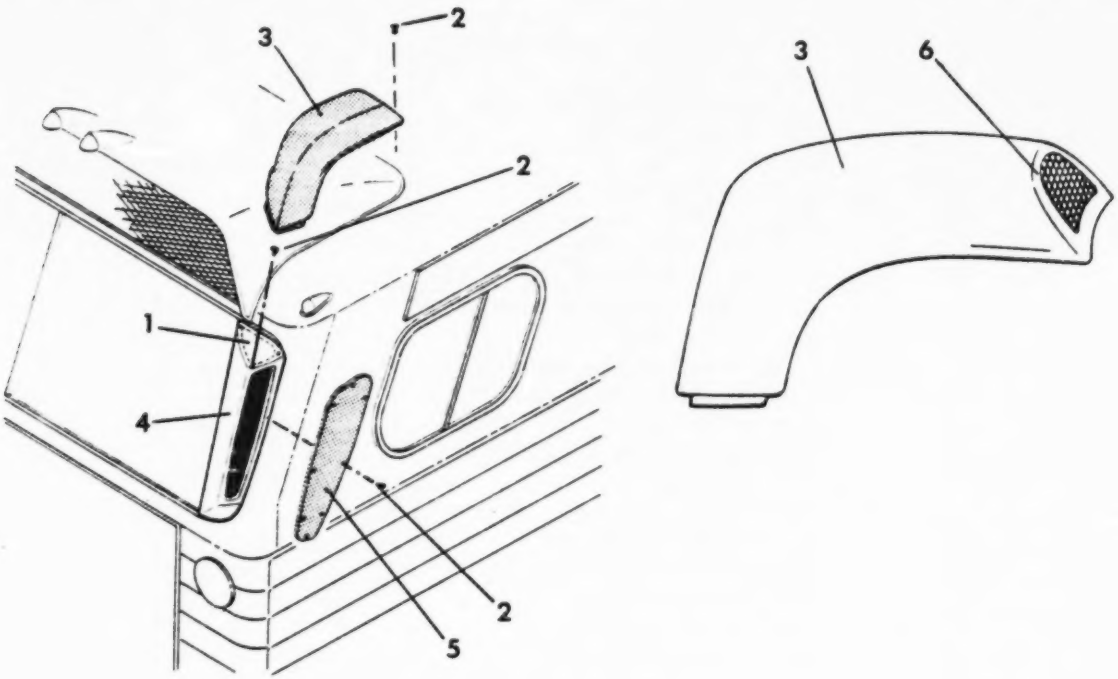
LEGEND FOR FIGURE 9.

Reference	Description	Quantity
1	Turbocharger	1
2	5½" Latch-type Band Clamp	1
3	6-to-5 Reducer	1
4	6½" Latch-type Band Clamp	1
5	45° Elbow, 6" OD	1
6	Safety Filter	1
7	1/8" NPT Street Ell	1
8	Restriction Indicator	1
9	1/8" NPT Pipe Plug	1
10	1" DIA Worm Screw Hose Clamp	1
11	1" ID Reinforced Rubber Hose	≈18"
12	6½" Band Clamp	2
13	Left Sweep Elbow Jacket	1
14	Right Sweep Elbow Jacket	1
15	7-to-6 Reducing 45° Elbow	1
16	7½" Latch-type Band Clamp	1
17	Air Cleaner	2
18	1/4" OD x 1" Copper Drain Tube	1
19	Replacement Element	*1
20	Mounting Band	2
21	Air Cleaner Strap	1
22	Switch Box Bracket	1
23	Air Cleaner Support	1
24	7½" Band Clamp	1
25	7-to-6 Reducer	1
26	Fuel Filter Bracket	1

*Included in Air Cleaner

AIR INTAKE SNORKLE

The air intake snorkle is installed in accordance with Figure 10. The template, SK-A-10020, is used to cut an opening in the top of the existing air intake cowl. The snorkle inserts into this hole and is held in place by screws. Another screw attaches the inlet end of the snorkle to the roof of the bus. The existing screen is removed from the cowl and the old inlet is closed by the plasic blank, SK-B-10016.



Legend

1 Snorkle Template SK-A-10020
2 Sheet Metal Screws
3 Holloway Snorkle SK-A-10017-A
4 Existing Intake Cowl
5 Intake Cowl Blank SK-B-10016
6 SS Wire Screen SK-A-10017-2

REFER TO DWGS:
SK-A-10016
SK-A-10017-A
SK-A-10020

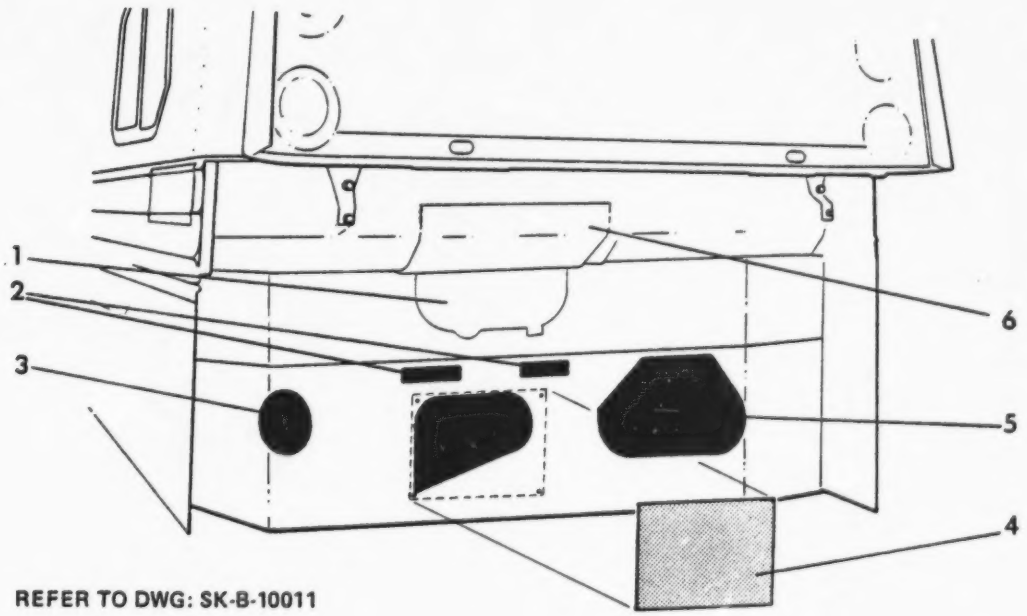
FIGURE 10.
HOLLOWAY SNORKLE INSTALLATION

EXHAUST SYSTEM

A new exhaust system is installed in order to provide the reduced back pressure required by the turbocharger (Table 3). The main changes are:

	Before	After
Tube size to muffler	4" diameter	4" diameter
Exhaust muffler	Nelson T-12023-F	Donaldson WOM12-083, modified
Tube size to stack	4" diameter	5" diameter
Exhaust aspirator	EIP Kit	Removed

The original exhaust tubing and muffler system from engine to outlet is removed. Their old passageway through the center of the firewall is covered with a steel plate as shown in Figure 11. Retaining screws pass through the firewall from front to rear and engage the cover plate on the rear side of the firewall.



REFER TO DWG: SK-B-10011

Legend

1 Access panel, seldom used and now covered by anti-noise padding
2 Plumbing passage
3 Freon compressor drive shaft passage
4 Newly fabricated exhaust pipe passage blank (SK-B-10011)
5 Drive line passage
6 Rear seat access hatch

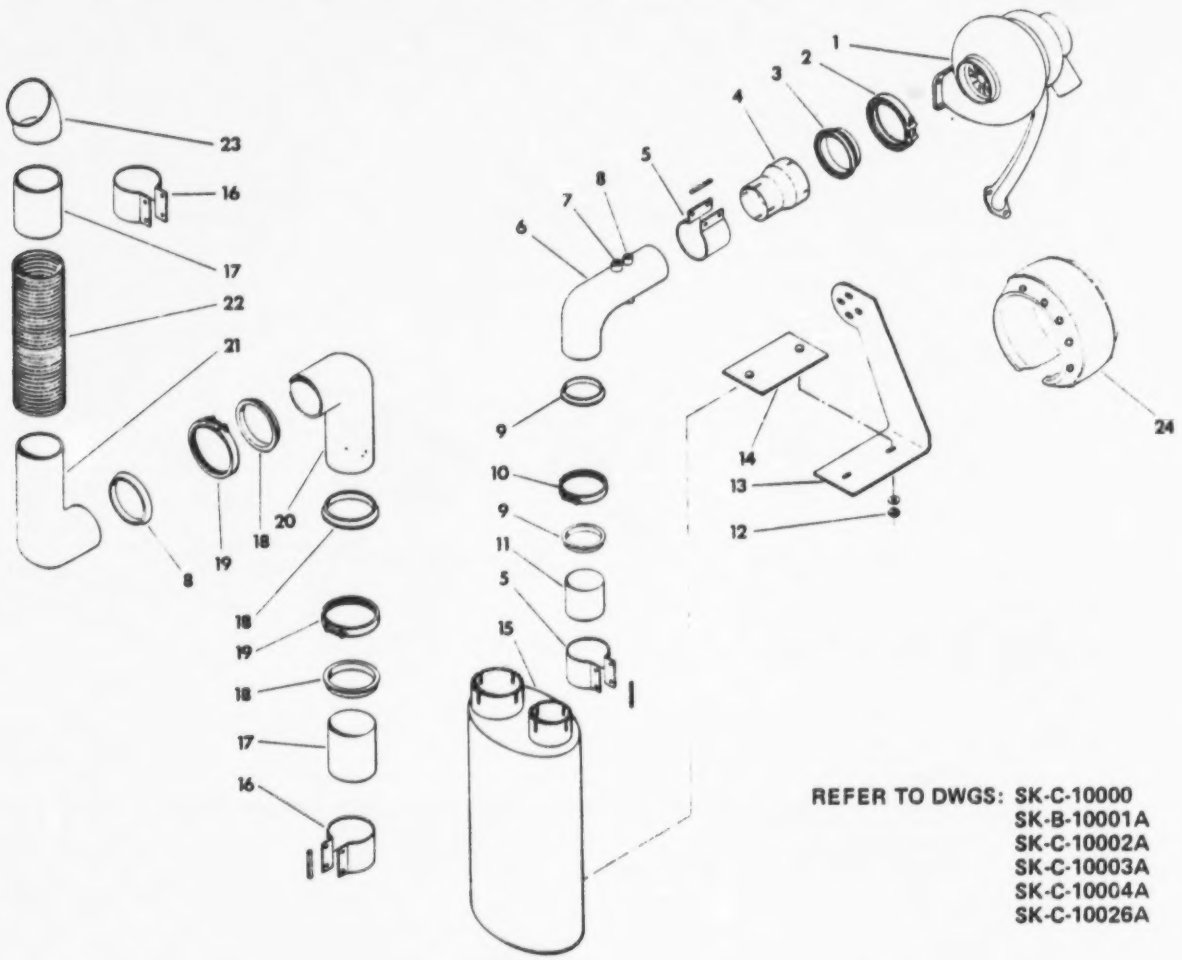
FIGURE 11.

EXHAUST PIPE PASSAGE COVER

Figure 12 depicts the new exhaust system. It features a new, smaller oval-shaped muffler. The muffler is relocated to the space between the engine and radiator formerly occupied by the "aspirator", a component of the so-called "Environmental Improvement Kit." The function of the aspirator was not replaced because it served no useful purpose to begin with.

The new muffler's body acts as a partial barrier to engine compartment noise emitting through the radiator opening. To compensate for its interference with access to the front of the engine, the muffler is bottom-mounted and jointed with v-band clamps to facilitate quick removal.

The plastic cowl located to the left of the rear window whose purpose is to conceal the stack is trimmed to fit the larger 5" diameter stack. A flexible tube section in the stack relieves stresses in the exhaust tubing produced by the relative motion between the engine and the chassis.



REFER TO DWGS: SK-C-10000
SK-B-10001A
SK-C-10002A
SK-C-10003A
SK-C-10004A
SK-C-10026A

FIGURE 12.
EXHAUST SYSTEM

LEGEND FOR FIGURE 12.

Reference	Description	Quantity
1	Turbocharger	1
2	V-band Clamp	1
3	Turbocharger Flange	1
4	5-to-4 ID-OD Reducer	1
5	4" Diameter Band Clamp	2
6	4" OD, 16 GA, MS Tube, 90° Elbow Ass'y	1
7	1/8" NPT Pipe Plug	1
8	1/4" NPT Pipe Plug	1
9	4" ID Pipe Flange	2
10	4" DIA V-band Coupling	1
11	4" OD x 4", 16 GA, MS Tube	2
12	5/16"-18NC Nut & Washer	2 ea.
13	Muffler Hanger	1
14	Muffler Mounting Plate Ass'y	1
15	Muffler	1
16	5" Diameter Band Clamp	2
17	5" OD x 6", 16 GA, MS Tube	2
18	5" ID Pipe Flange	4
19	5" DIA V-band Coupling	2
20	5" OD, 16 GA, MS Tube, 90° Elbow, 12 3/16 Long	1
21	5" OD, 16 GA, MS Tube, 90° Elbow, 13 7/8" Long	1
22	5" ID x 18", SS Flex Tube	1
23	5" OD, 16 GA, SS Tube, 45° Elbow	1
24	Turbocharger Blanket	1

AIR DRYER HISS

The air dryer is a safety device, yet it sounds dangerous. Located just downstream from the compressor, it removes condensate from the newly compressed air before the air reaches the valves, chambers, and reservoirs of the air brake system where freezing might cause blockage. Each time the compressor replenishes the air storage tanks, the same signal that unloads the compressor opens the dryer's sump valve, allowing the pent up air within to blow the collected condensate down onto the street below. This causes a loud, prolonged hissing noise. Often this will occur about a half-block after the bus pulls away from a boarding station. Since it sounds like something dramatic is happening with the airbrakes, it scares people, creating an unnecessary sense of alarm and annoyance.

Figure 13 shows a harmless way to silence the air dryer. Simply run a line from the sump to the exhaust pipe upstream of the muffler where there is a fitting provided. Any condensate, oil carryover, or other debris in the air dump is safely dissipated in the hot exhaust gas.

REF.	DESCRIPTION
1	Air Dryer
2	Adapter
3	1/4 NPT Male Elbow
4	Brass Insert
5	3/8" OD Nylon Tube
6	Union Elbow
7	3/8" OD Copper Tube
8	90° Elbow
9	1/4" NPT Male Connector

REFER TO DWG: SK-A-10008-A

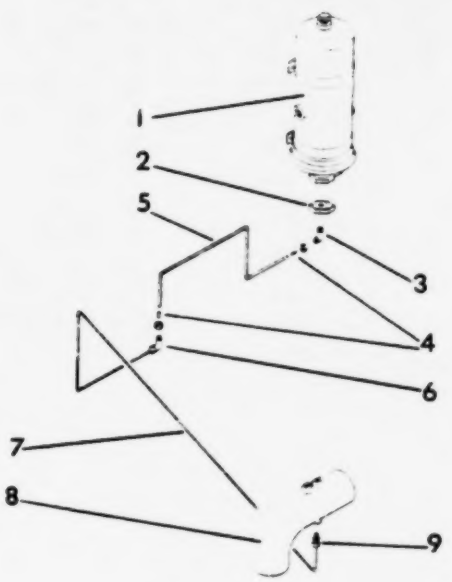


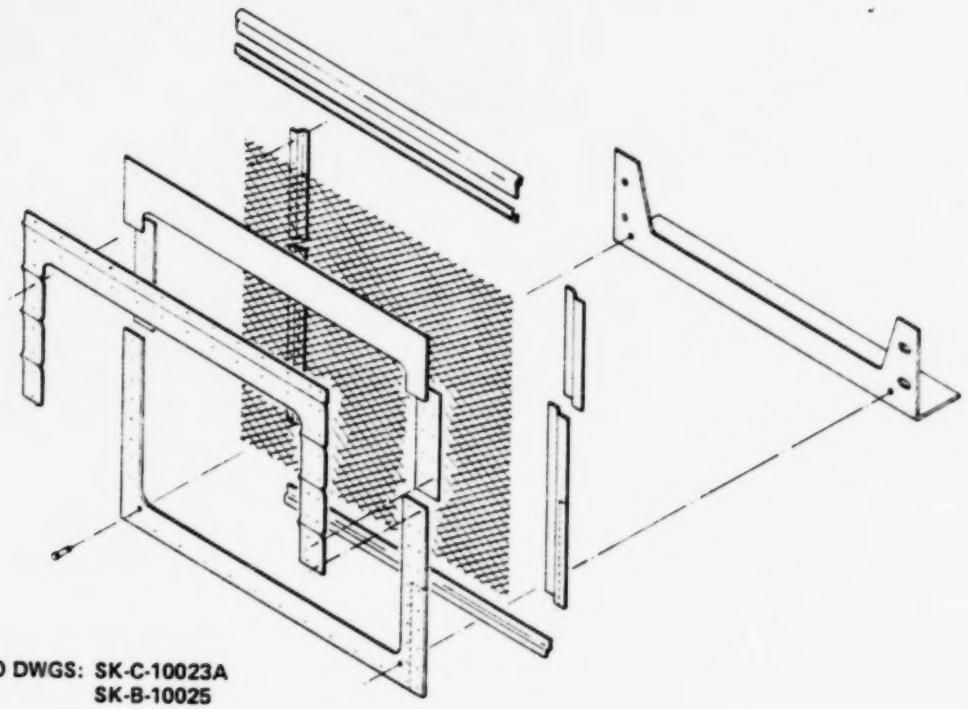
FIGURE 13.
AIR DRYER SILENCING

RADIATOR GRILLE

The turbocharger removes heat from the exhaust gas. Most of this missing heat is transferred to the engine's cooling system. The cooling load is increased 11%. To offset this extra load, the radiator grille is rebuilt, giving a 45% larger net area. This results in a 12% increase in air flow at the same fan speed which, in turn, results in a 7% greater heat rejection from the same radiator without a rise in coolant temperature. The end result is a slight reduction in the cooling system's capacity. However, the cooling system has surplus capacity in our buses to prevent overheating of the engine in any environmental condition, provided that it is kept in reasonably good working order. Therefore, rather than take the next step, which would be to replace the existing 4-tube row radiator core with a 5-row core, it is better to pay attention to routine service items such as:

1. Steamclean air side of radiator and keep clean.
2. Do not discard any part of the fan shroud.
3. Keep fan centered in shroud.
4. Keep fan drive thermostat valve working.

Figure 14 shows how the existing grille is salvaged and rebuilt.



REFER TO DWGS: SK-C-10023A
SK-B-10025

FIGURE 14.
REWORKED RADIATOR GRILLE

Figure 15 compares the old grille with the new grille.

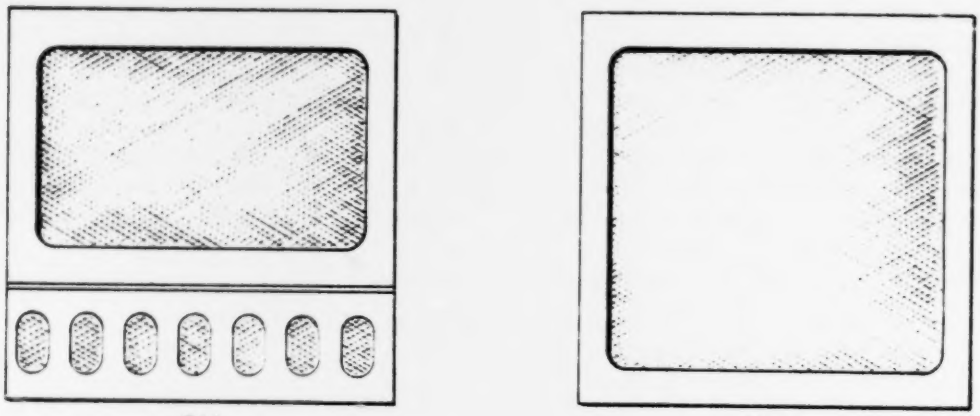


FIGURE 15.
OLD AND NEW GRILLES

A grille having a still greater open area does not result in a further increase in air flow. This is because the "bottleneck" lies elsewhere. The net open area of the radiator core is 720 in^2 and the area of the shroud opening is 710 in^2. The next step in improving air flow would be either to redesign the fan-shroud interaction or increase the size of the radiator, shroud, and fan.

ESTIMATED COST

It is estimated that the cost of applying the treatment is about $6,000 per bus. Most of this amount is associated with turbocharging the engine. In making this estimate, itemized in Table 4, it is assumed that:

Only one or a few buses will be treated at a time.
Workmen are unrehearsed, but supervised and well motivated.
No special tooling is built up.
Common tools, parts, materials, and outside fabricators are available.
Prices are at the 1979 level.
Shop labor and overhead rate is $20 per man-hour.
Purchases are below levels deserving quantity discounts.

In the interest of economy, the engine is turbocharged at the same time it is undergoing an overhaul. The net cost of rebuilding the engine into an 8V-71T over the cost of restoring it to an 8V-71N is used.

TABLE 4.

COST ESTIMATE

SHOP LABOR	Build Up	Install	Total
Overhaul to 8V-71T	42	8	50
Overhaul to 8V-71N	32	8	40
Net to turbocharge	10	0	10
Anti-noise padding	7½	5½	13
Air intake system	½	2½	2½
Oil filters, etc.	1	2½	3½
Air intake snorkle	½	1	1½
Exhaust system	2½	6½	9
Air dryer line		2	2
Radiator grille	3½	½	4
Total man-hours	25½	20½	45½

COSTS	Purchased Parts	Build Up Labor	Outside Fabricate	Install Labor	Total
Overhaul to 8V-71T	$7,200	$840	$ 0	$160	$8,400
Overhaul to 8V-71N	4,800	640	0	160	5,800
Net to turbocharge	2,400	200	0	0	2,600
Anti-noise padding	611	150	0	110	871
Air intake system	514	5	50	45	614
Oil filters, etc.	40	20	0	50	110
Air intake snorkle	12	10	600	20	642
Exhaust system	578	50	210	130	968
Air dryer line	20	0	0	40	60
Radiator grille	20	70	0	10	100
Total cost	$4,195	$505	$860	$405	$5,965

ACOUSTICS

Sound is vibration in air...pressure waves. Noise is unwanted sound.

The human ear is an extremely sensitive and delicate organ. A young person can detect a sound whose air pressure is only one two-ten thousandths of a millionth of an atmosphere. The ear can momentarily function even when exposed to sound pressure 10 million times this threshold.

Sound is measured with a sound level meter and is usually expressed in terms of A-weighted decibels. The sound level meter consists of a microphone, an amplifying electronic network, and a readout. Too many digits would be involved if sound were expressed in plain pressure units, so decibels are used to make the numbers simpler. A decibel is 20 times the logarithm (power of ten) of the ratio of the measured sound pressure to a reference sound pressure. The reference is the threshold of human hearing. A sound having a thousand times the pressure of the human threshold would have a decibel rating of 60 dB. A-weighting means that the signal is sent through a filter that downgrades low frequency sound corresponding to the response of the human ear.

One does not use simple arithmetic with decibels. For example, 80 dBA plus 80 dBA does not equal 160 dBA. As a matter of fact, every time sound pressure doubles, the sound level increases by 3 dBA. 80 + 80 = 83 dBA.

If one sound is 10 dBA louder than another, the lesser is masked out. That is, the sound level of the two together is not detectably greater than the greater sound. When a particular noise source is 10 dBA less than the overall noise, then it is unimportant.

Distance has a predictable effect on sound level. Each time one doubles the distance to a sound source radiating from a point in an echo-free space, the sound level drops by 6 dBA.

Juries won't agree that there is a difference in level when sounds less than 3 dBA are compared. A sound 10 dBA less than another seems half as loud.

When trying to stop noise by putting a box around the source, one should keep these things in mind:

1. A lot of noise comes through a small hole. An air leak is usually a noise leak too.
2. Kill "live" panels (they ping when you strike them) by stiffening them or by gluing something heavy to them.
3. The walls of the box have to be relatively heavy. Usually a pound or two per square foot is enough.
4. Some kind of sound absorptive lining inside of the box is good because it reduces echoes inside. If it becomes less noisy inside the box, it will become less noisy outside the box too.
5. If you can't put a complete box around the source, at least try to put barriers to cut off line-of-sight noise. That is better than leaving open holes.

A bus is a chorus of individual noises. These can be grouped as engine compartment noise, fan noise, exhaust outlet noise, muffler and exhaust pipe shell noise, and tire and body noise.

Engine noise is both sensitive to speed and power. It has a harsh, unpleasant quality. It is the most difficult noise source to treat and is therefore usually the dominant source after the overall bus has been treated. It can be helped by the engine manufacturer through smoothing of the onset of combustion, by stiffening the block, and by curing "hot spots." But, this takes a long time and is expensive. Other treatments are turbocharging and encapsulation.

The fan makes a whirring sound, coming from where the blade tips chop the air. It is steeply sensitive to fan speed, so a modulating speed drive is better for noise control than an on-off drive. At least sometimes you will hear the fan if it has an on-off drive, but you might never be bothered by fan noise with a modulating speed drive. Nothing much can be done to cure fan noise except to slow the fan down. This is more easily done at the factory through the use of larger radiators than in the field.

Exhaust outlet noise is more mellow and musical. Most uninitiated believe they are hearing exhaust noise and blame the muffler when a loud bus goes by. It might well be a break in the exhaust piping upstream of the muffler, or more often just plain engine noise they are hearing. Exhaust noise is relatively easy to treat. All one needs is a proper muffler. With turbocharged engines, there is a need for low back pressure. This leads to the problem of finding room for the adequate muffler. To have low back pressure *and* good silencing, a muffler can't be kept small.

Muffler and exhaust pipe shell noises might be revealed as treatment of the louder engine, exhaust, and fan noises progresses. Common practice is to double the skin of the muffler body when used with naturally aspirated engines. The need is less with turbocharged engines. Pipe shell noise does not ordinarily require treatment, but there might be significant noise radiating from flexible tube sections.

Tire noise is unimportant at speeds below 40 mph for the ordinary bus. Even after treatment, tire noise is masked out at speeds below 30 mph. Body noise can be a nuisance if there are loose doors and windows.

Noise radiates in all directions from a bus of the type we treat here, but not evenly. Less noise radiates forward because the bus body is a barrier to engine noise in the rear. The bus is noisier on the left side than on the right, not because the exhaust stack is on that side, but because the radiator opening is there... an open door to noise from the engine compartment. Fortunately, the boarding passengers are exposed to right side noise which is quieter and easier to treat than left side noise.

We believe the operator of a city transit bus should judge a treatment by its effect on the ordinary noise a bus makes most of the time; not on the maximum noise it makes only once in awhile. A treatment that reduces the one does not necessarily reduce the other. Consequently, we believe it is better to evaluate the bus with its fan drive in the "as-is" condition and not artificially locked up. We use the following criteria:

Exterior Noise.
Average of right side and left side peak sound level during a 50-foot full acceleration pass-by through first upshift.

Interior Noise.
Average of rear seat and driver's seat peak sound level during full acceleration through first upshift.

By these criteria, the results of treating a bus in accordance with this Retrofit Instruction are:

	As-Is Average Exterior Rating*	As-Is Average Interior Rating*
Baseline (Typical Tri-Met)	79½ dBA	79½ dBA
After Treatment	75½ dBA	76½ dBA
Reduction	4 dBA	3 dBA

*Rounded to the nearest ½ dBA

An acoustically effective bellypan would make possible a further reduction to the average exterior rating of at least 3dBA, but this has not been reduced for practical hardware.

A more detailed breakdown by side and source is given in Table 4. This enables comparison with other standards such as the U.S. EPA proposed rule for regulating manufacturers of buses. The EPA rule is "worst-case" oriented. It considers only the "fan-on" condition and the louder side or end. The proposed levels are:

	Exterior	Interior
First year	83 dBA	86 dBA
Fifth year	80 dBA	83 dBA
Seventh year	77 dBA	80 dBA

TABLE 5.

NOISE SOURCE DIAGNOSIS BEFORE AND AFTER TREATMENT
Measured by EPA 50-foot Acceleration Pass-by Test

(Rounded to Nearest ½ dBA)

BASELINE

EXTERIOR		LEFT	RIGHT
SOURCE	ENGINE	79	77½
	SHELL	73	70
	EXHAUST	66	65
	TIRES	58	58
	FAN ON	77	76½
	FAN AS-IS	71	70½
OVERALL	FAN ON	*82	81
	FAN AS-IS	80	79
	FAN OFF	80	78½
INTERIOR		REAR	FRONT
	FAN ON	*83½	77½
	FAN AS-IS	83	76

TREATED

EXTERIOR		LEFT	RIGHT
SOURCE	ENGINE	74½	73½
	SHELL	NIL	NIL
	EXHAUST	65	64
	TIRES	58	58
	FAN ON	77½	73
	FAN AS-IS	71	65
OVERALL	FAN ON	*79½	76½
	FAN AS-IS	76½	74½
	FAN OFF	75	74
INTERIOR		REAR	FRONT
	FAN ON	*80½	74½
	FAN AS-IS	80	73

*Comparable to EPA Rating

EFFECTS ON PERFORMANCE

Table 5 quantifies the side-effects of the noise control treatment on various aspects of bus performance. It complements the data presented in Table 3. In general, emissions and aspiration are improved, delivered power and fuel economy are unchanged or slightly improved, cooling system capacity is affordably decreased. Predicted aggregate maintenance costs are not measurably changed.

TABLE 6.

PERFORMANCE BENCHMARKS BEFORE AND AFTER TREATMENT

(#1 Diesel Fuel)

	UNITS	BASELINE	TREATED
POWER OUTPUT			
Terminal Speed on 4% Grade	mph	45½	46
[1]Acceleration on Flat 200-foot Time	sec	8.7	8.8
[2]Engine Dynamometer Full throttle, 2,000 rpm	BHP	218	220
FUEL MILEAGE			
Average Mission	mpg	[3]4.22	[4]4.40
COOLING SYSTEM			
Full Speed on 4% Grade	[5]°F ATB	134°	127½°
Fan Delivery, 1,500 rpm	CFM	10,500	12,000
ASPIRATION (Full Power, 2,000 rpm)			
Exhaust Back Pressure	"Hg	5.6	2.1
Exhaust Temperature	°F	810°	560°
Intake Restriction	"H_2O	7	11

[1] Full throttle from a standing start.

[2] Data supplied by engine manufacturer.

[3] 2-year fleet average.

[4] 5½ months in-service average.

[5] The ambient air temperature at which the coolant would theoretically warm up to the boiling point of water, 212°F.

ABBREVIATIONS

AGE	Aluminized Glass Edging Tape
AL, ALUM	Aluminum
ATB	Air-to-Boil Temperature
µbar	One-millionth of an atmosphere of pressure
B.C.	Bolt Circle
BHP	Brake Horsepower
BMEP	Brake Mean Effective Pressure
BSFC	Brake Specific Fuel Consumption
BTU	British Thermal Unit
CFM	Cubic Feet per Minute
CO	Carbon Monoxide
dBA	A-weighted decibel referenced to .0002 µbar
DIA, dia	Diameter
DWG	Drawing
EIP	Environmental Improvement Package
°F	Degree Fahrenheit
Flex	Flexible
ft^2	Square Foot
GA	Gage
GPM	Gallons per Minute
HC	Hydrocarbons
"Hg	Inches of Mercury
"H_2O	Inches of Water
hr	Hour
ID	Inside Diameter
in^2	Square Inches
INST.	Installation
L.B.	Left Bank
lbs	Pounds
min	Minute
mm	Millimeter
mpg	Miles per Gallon
mph	Miles per Hour
M.S.	Mild Steel
MTG	Mounting
NC	National Coarse Thread
NO_2	Nitrous Oxide
NPT	National Pipe Thread
OD	Outside Diameter
oz	Ounce
PPM	Parts per Million
psi	Pounds per Square Inch
R, RAD	Radius
REF	Reference
R.B.	Right Bank
rpm	Revolutions per Minute
sec	Second
S.S.	Stainless Steel
TYP	Typical

APPENDIX A.

PURCHASE LIST

Notes:

1. Parts for turbocharge rebuild to be negotiated with local Detroit Diesel dealer.
2. Common fasteners not called out.

Quantity	Brand or Manufacturer	Size or Part Number	Description	Where Used
1	Aeroquip	55083-650-2	6½" Band Clamp	SK-C-10010A
1	Aeroquip	MB9460-S-100-N-750	7½" Latch Band Clamp	SK-C-10010A
1	Aeroquip	55083-750-2	7½" Band Clamp	SK-C-10010A
1	Aeroquip	MB9360-S-075-N-550	5½" Latch Band Clamp	SK-C-10010A
1	Aeroquip	MB9460-S-100-N-650	6½" Latch Band Clamp	SK-C-10010A
2	Aeroquip	MLJ 8750-500S	5" Servicemaster	SK-C-10002A
1	Aeroquip	MLJ 8750-400S	4" Servicemaster	SK-C-10002A
1	Bostitch	P50-5B	Pnuematic Stapler	IC Pads
1	Bostitch	SB-5019-5/8"	S.S. Staples	IC Pads
40" x 88"	Carborundum	Grade FW35	Flexweave 1000 Cloth	SK-A-10003A
1	Detroit Diesel	5101814	Turbocharger Flange	SK-C-10005A
1	Detroit Diesel	5132650	V-Band Clamp	SK-C-10005A
2	Donaldson	17061	5" Sealclamp	SK-C-10002A SK-C-10004A
2	Donaldson	KYX00-4482	4" Sealclamp	SK-C-10005A
1	Donaldson	5080B79	WOM12-83, Modified	SK-C-10004A
1	Donaldson	21067	4-5 ID-OD Reducer	SK-C-10005A
1	Donaldson	23013	6" OD 45° Elbow	SK-A-10009A
1	Donaldson	P10-0089	Safety Filter	SK-C-10010A
1	Donaldson	RBX00-2278	Restriction Indicate	SK-C-10010A
1	Donaldson	ECG11-2000	Air Cleaner	SK-C-10010A
2	Donaldson	P00-4079	Mounting Band	SK-C-10010A
18" Long	Federal	R200S	5" ID S.S. Flex Tube	SK-C-10002A
1	HITCO	298S27644	Turbo-Charger Blkt.	SK-C-10026A
1	HITCO	298S27664	L.B. Elbow Blanket	SK-C-10010A
1	HITCO	298S27663	R.B. Elbow Blanket	SK-C-10010A
1	Holloway	SK-A-10017A	Snorkle	Sk-A-10024A
1	Huntington	60R50	6-5 Rubber Reducer	SK-C-10010A
1	Huntington	70R60	7-6 Rubber Reducer	SK-C-10010A
1	Huntington	45HL70R60	7-6 Reducer 45°Elbow	SK-C-10010A
1 25' Roll	Insul-Coustic	Type 6, 10 oz/ft^2	48" Wide Insul-Quilt	IC Pads
1 Roll	Insul-Coustic	3" Wide x 400 Yards	AGE Tape	IC Pads
6	Insul-Coustic	IC 998	Adhesive Cartridge	IC Pads

APPENDIX A.

PURCHASE LIST CONTINUED

Quantity	Brand or Manufacturer	Size or Part Number	Description	Where Used
15" x 38"	Local Supply	3/16" Thick	M.S. Plate	SK-C-10000 SK-B-10001A
20" x 28"	Local Supply	1/8" Thick	M.S. Plate	SK-A-10011 SK-B-10012 SK-A-10013 SK-B-10014
3" x 15"	Local Supply	1/4" Thick	M.S. Plate	SK-C-10015A
14" x 36"	Local Supply	5/32" Thick	M.S. Plate	SK-C-10023A
26" x 32"	Local Supply	1/8" Thick	Alum Sheet	SK-C-10021A
6'	Local Supply	1/8" x 3" x 3"	Alum Angle	SK-C-10019A
31" x 33"	Local Supply	1" x 2" Diamond	M.S. Expanded Mesh	SK-C-10023A
1" Long	Local Supply	1" OD x .065" Wall	M.S. Tube	SK-A-10009A
1" Long	Local Supply	1/4" OD	Copper Tube	SK-C-10010A
6'	Local Supply	SAE J844B, Type 1	3/8" OD Copper Tube	SK-A-10008A
10'	Local Supply	SAE J844B, Type 3	3/8" OD Nylon	SK-A-10008A
2" Long	Local Supply	2" Hexagonal	Brass Bar	SK-A-10007
6" x 24"	Local Supply	1/8" Thick	Polypropylene Sheet Haircell Black	SK-B-10016
2'	Local Supply	1" OD	Rein Rubber Hose	SK-C-10010A
1	Local Supply	5" OD, 16 GA	S.S. 45° Elbow	SK-C-10002A
4	Local Supply	1/8" NPT	Pipe Coupling	SK-C-10005A SK-C-10009A
1	Local Supply	1/4" NPT	Pipe Coupling	SK-C-10005A
3	Local Supply	1/8" NPT	Pipe Plug	SK-C-10005A SK-C-10009A SK-C-10010A
1	Local Supply	1/4" NPT	Pipe Plug	SK-C-10005A
1	Local Supply	1" DIA	Worm Hose Clamp	SK-C-10010A
1	Parker	2202P-2-2	1/8" NPT Street Ell	SK-C-10010A
1	Parker	269CA-6-4	1/4" NPT Male Elbow	SK-A-10008A
1	Parker	165CA-6	Union Elbow	SK-A-10008A
2	Parker	63PT-6-62	Brass Insert	SK-A-10008A
1	Parker	68CA-44	1/4" NPT Male Conn.	SK-A-10008A
12" x 12"	Western Wire	16 GA, 4 Mesh	T304 S.S. Screen	SK-A-10017A

APPENDIX A.

SPECIALTY SUPPLIERS

HITCO Insulation Products
2302 Marietta Blvd, N.W.
Atlanta, Georgia 30318
(404) 355 1205

Insul-Coustic
Jernee Mill Road
Sayreville, New Jersey 08872
(201) 257 6674

Huntington Rubber Co.
6800 S.W. Macadam Blvd.
Portland, Oregon 97219
(503) 246 5411

Holloway Product Development
14023 N.W. Science Park Drive
Portland, Oregon 97229
(503) 643 7338

Carborundum Co.
Insulation Division
P.O. Box 808
Niagra Falls, N.Y. 14302
(716) 278 6221

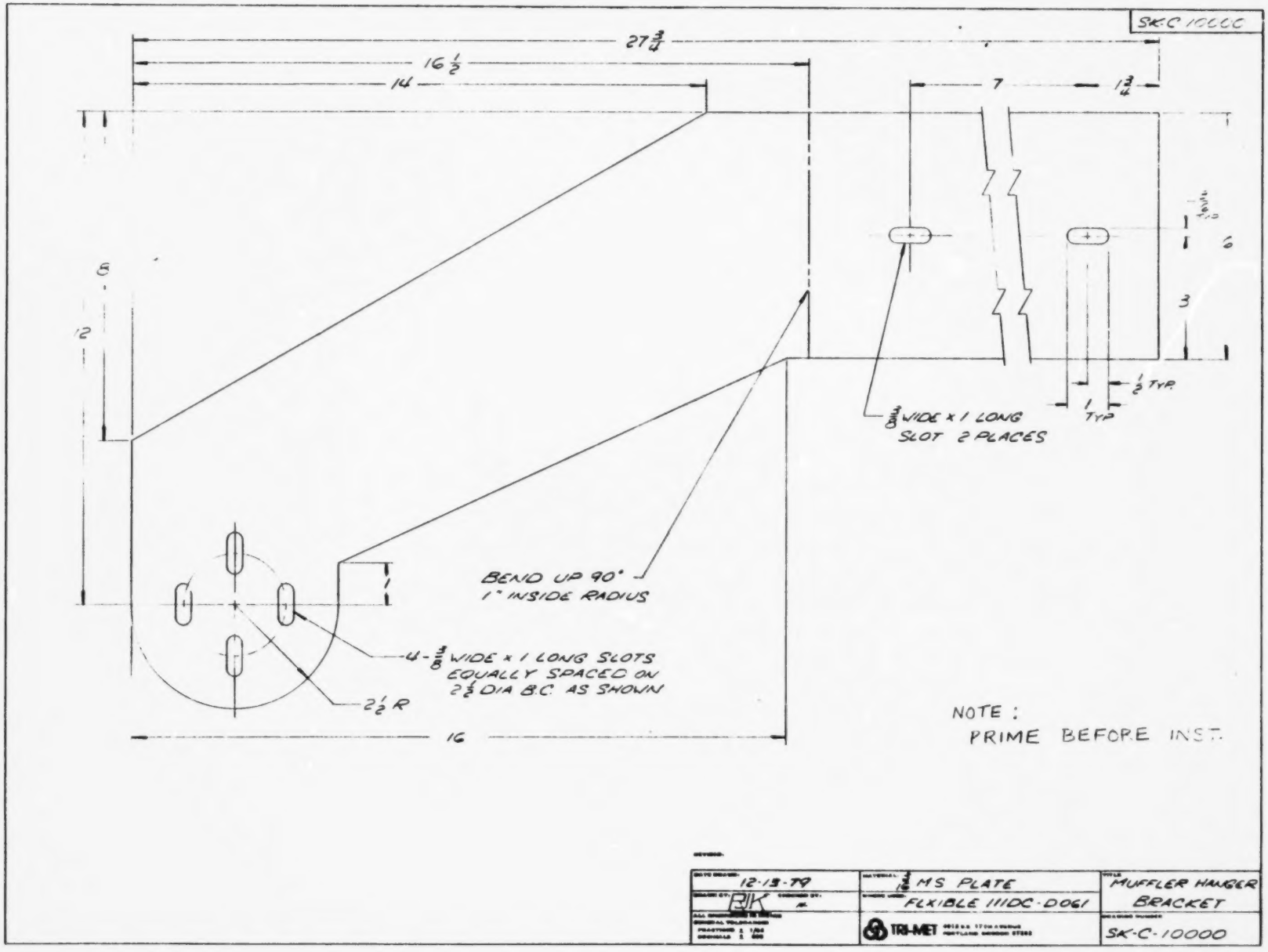
Donaldson Co., Inc.
1400 W. 94th St.
Minneapolis, Minnesota 55440

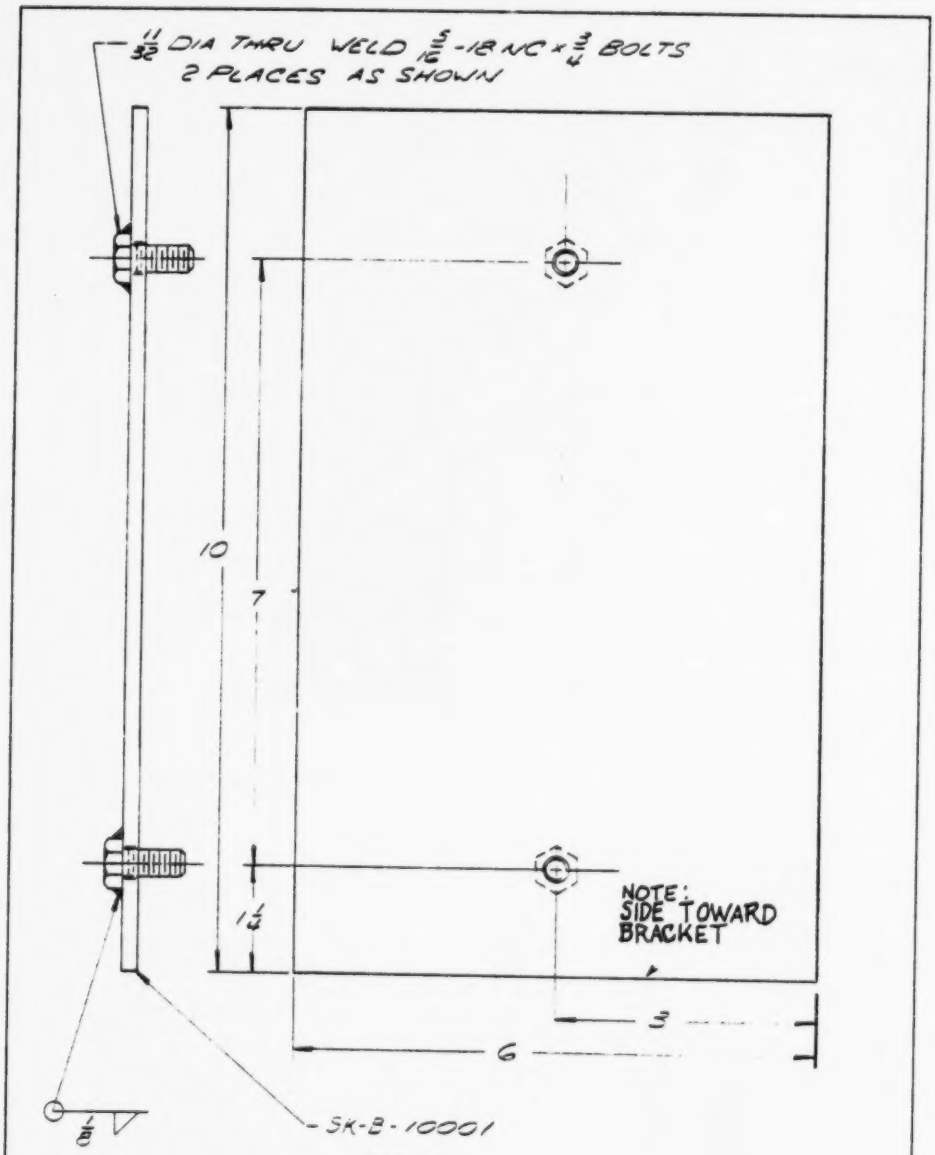
Western Wire Works
4025 N.W. Express
Portland, Oregon 97210
(503) 222 1644

APPENDIX B.

TRI-MET DRAWINGS

Number	Title
SK-C-10000	MUFFLER HANGER BRACKET
SK-B-10001A	MUFFLER MOUNTING PLATE ASS'Y
SK-C-10002A	UPPER EXHAUST ASS'Y
SK-A-10003A	MUFFLER JACKET ASS'Y
SK-C-10004A	LOWER EXHAUST ASS'Y
SK-C-10005A	EXHAUST INLET ASS'Y
SK-A-10007	DRYER ADAPTER
SK-A-10008A	DRYER AIR LINE INST
SK-C-10009A	INTAKE ELBOW ASS'Y
SK-C-10010A	INTAKE SYSTEM INST
SK-B-10011	FIREWALL BLANK
SK-B-10012	AIR CLEANER SUPPORT
SK-A-10013	SWITCH BOX BRACKET
SK-B-10014	FUEL FILTER BRACKET
SK-C-10015A	AIR CLEANER STRAP ASS'Y
SK-B-10016	INTAKE COWL BLANK
SK-A-10017A	HOLLOWAY SNORKLE ASS'Y-FLX
SK-C-10018A	REAR DOOR PADDING
SK-C-10019A	DOOR STOP
SK-A-10020	SNORKLE TEMPLATE
SK-C-10021A	FIREWALL PADDING
SK-C-10022A	RADIATOR PADDING
SK-C-10023A	REBUILT GRILLE
SK-A-10024A	SNORKLE INST
SK-B-10025	GRILLE SUPPORT
SK-C-10026A	EXHAUST SYSTEM INST

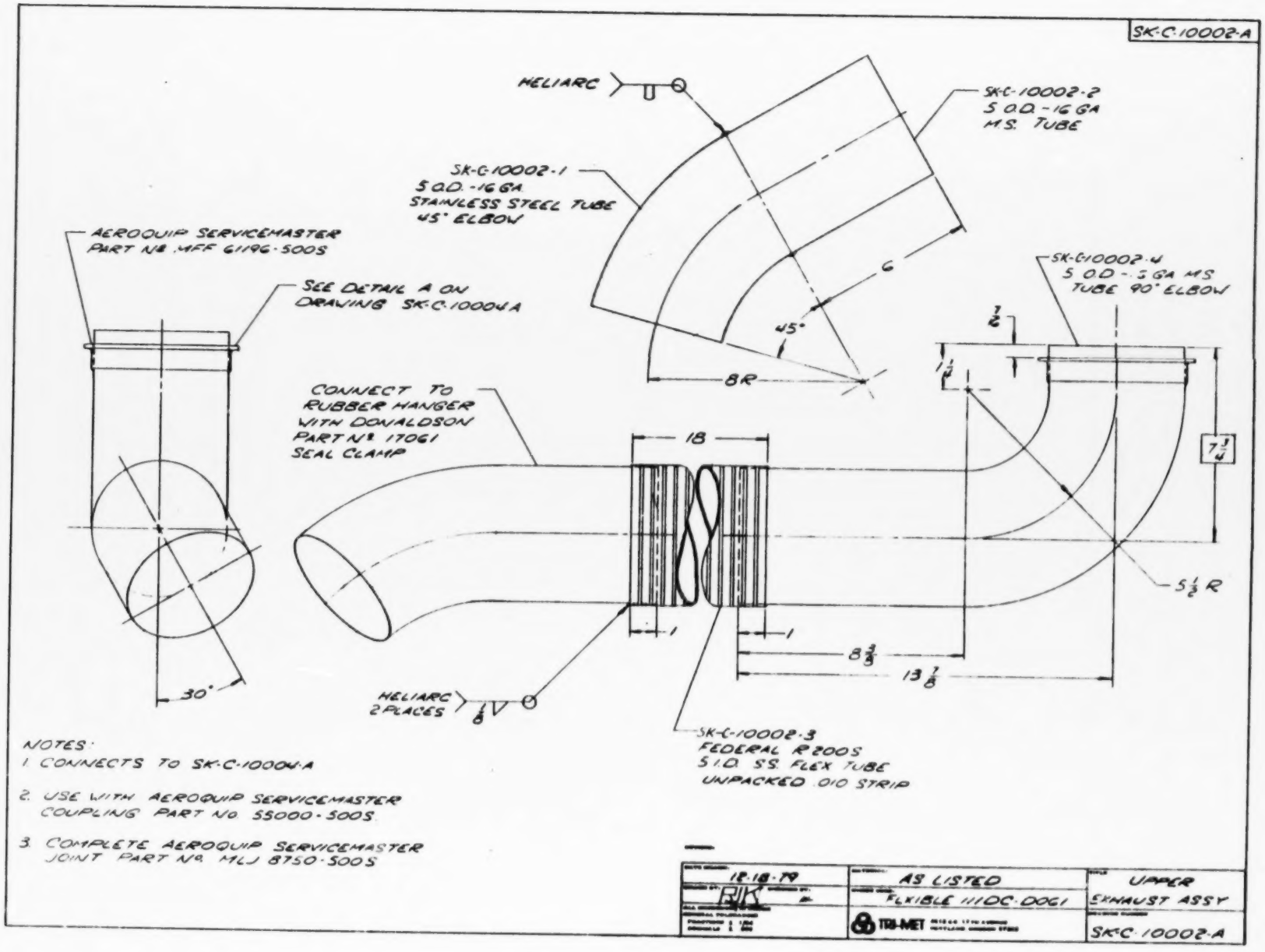

SK-C 10000
27 3/4
16 1/2
14
7
1 3/4
12
6
3
1/2 TYP
1 TYP
3/8 WIDE x 1 LONG SLOT 2 PLACES
BEND UP 90°
1" INSIDE RADIUS
4 - 3/8 WIDE x 1 LONG SLOTS EQUALLY SPACED ON 2 1/2 DIA B.C. AS SHOWN
2 1/2 R
16
NOTE :
PRIME BEFORE INST.
12-13-79
BJK
3/16 MS PLATE
FLXIBLE 1111DC-0061
TRI-MET
MUFFLER HANGER BRACKET
SK-C-10000



NOTE:
FIELD WELD ACROSS BOTTOM
OF MUFFLER AFTER ALIGNMENT
WITH EXHAUST SYSTEM

REVISED:

DATE DRAWN: DEC '9. 1979	MATERIAL: 3/16 M.S. PLATE	TITLE: MUFFLER MTG PLATE ASS'Y
DRAWN BY: RJK CHECKED BY: ML	WHERE USED: FLXIBLE 1110C-0061	
ALL DIMENSIONS IN INCHES GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-B-10001A

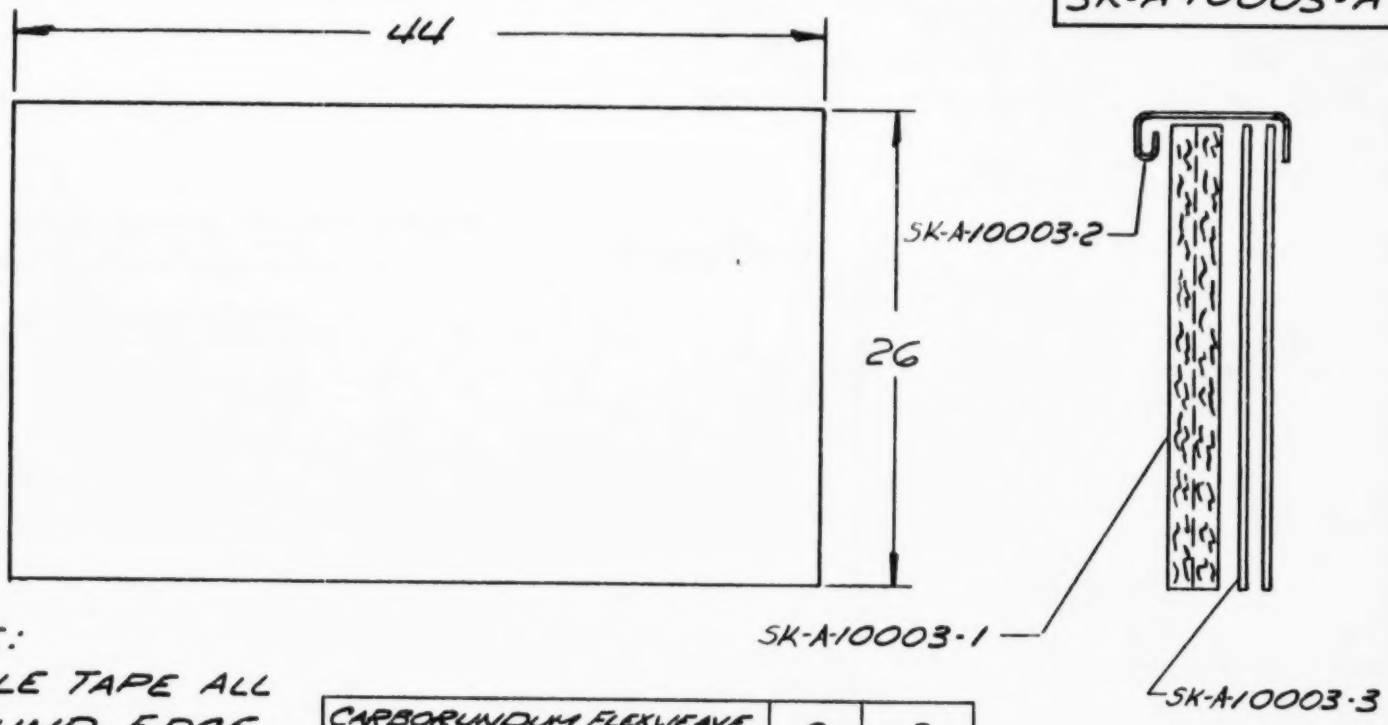


NOTES:

1. CONNECTS TO SK-C-10004-A
2. USE WITH AEROQUIP SERVICEMASTER COUPLING PART NO. 55000-5005
3. COMPLETE AEROQUIP SERVICEMASTER JOINT PART NO. MLJ 8750-5005

12-18-79	AS LISTED	UPPER EXHAUST ASSY
RJK	FLXIBLE 1110C-0061	
	TRI-MET	SK-C-10002-A

SK-A-10003-A



NOTE:
STAPLE TAPE ALL AROUND EDGE
STAPLE SPACING
1 - 1 1/2

REVISED:

	QTY	DASH
CARBORUNDUM FLEXWEAVE 1000 CLOTH GRADE FW35	2	3
INSUL-COUSTIC AGE TAPE 3" WIDE	1	2
INSUL-QUILT TYPE G 10 OZ/SQ FT.	1	1

DATE DRAWN: 12-16-79

MATERIAL:

DRAWN BY: RJK CHECKED BY: MK

WHERE USED: FLXIBLE 1110C-D061

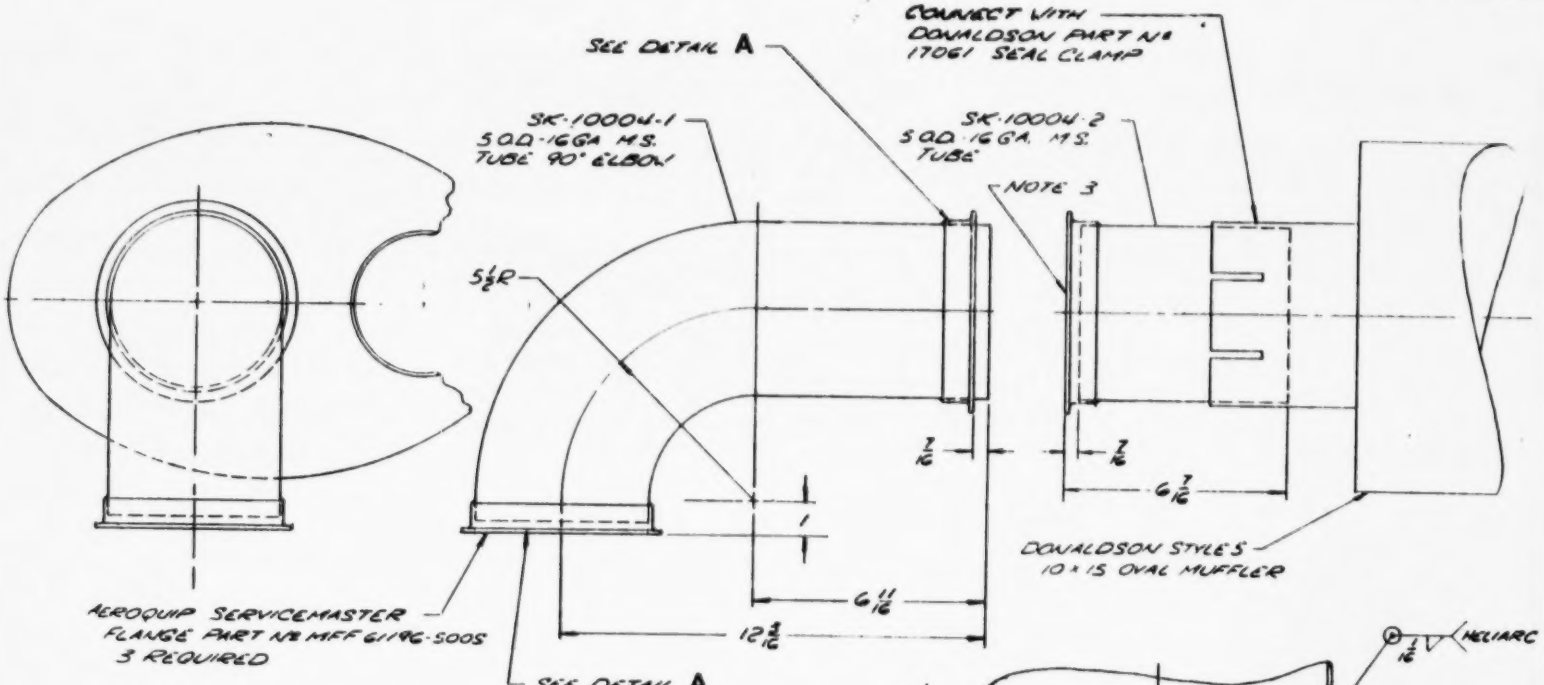
TITLE: MUFFLER JACKET ASS'Y

ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005

TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202

DRAWING NUMBER: SK-A-10003 A

SK-C-10004-A

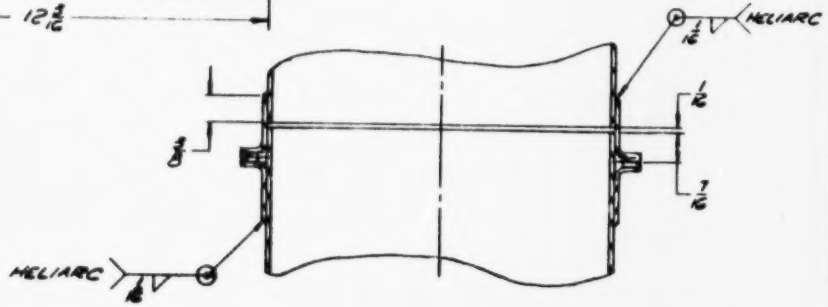


NOTE:

1. CONNECTS TO SK-C-10002A

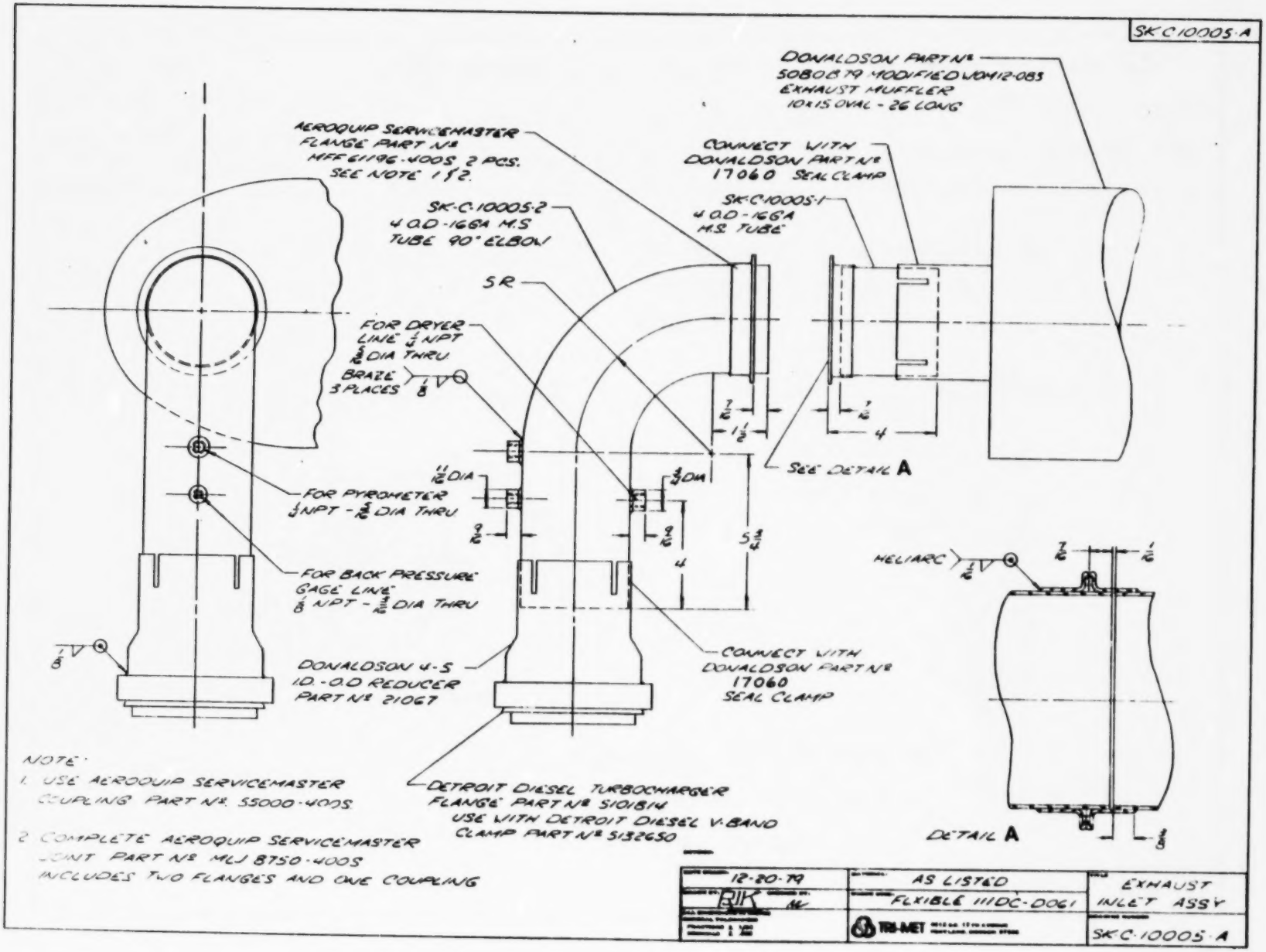
2. USE AEROQUIP SERVICEMASTER COUPLING PART No 55000-5005

3. COMPLETE AEROQUIP SERVICEMASTER JOINT PART No MLJ 8750-5005 (INCLUDES TWO FLANGES AND ONE COUPLING



DETAIL A

DATE DRAWN: 12-18-79	MATERIAL: AS LISTED	TITLE: LOWER EXHAUST ASSY
DRAWN BY: BJK CHECKED BY:	FLEXIBLE 1111DC-0061	
TRI-MET		SK-C-10004-A



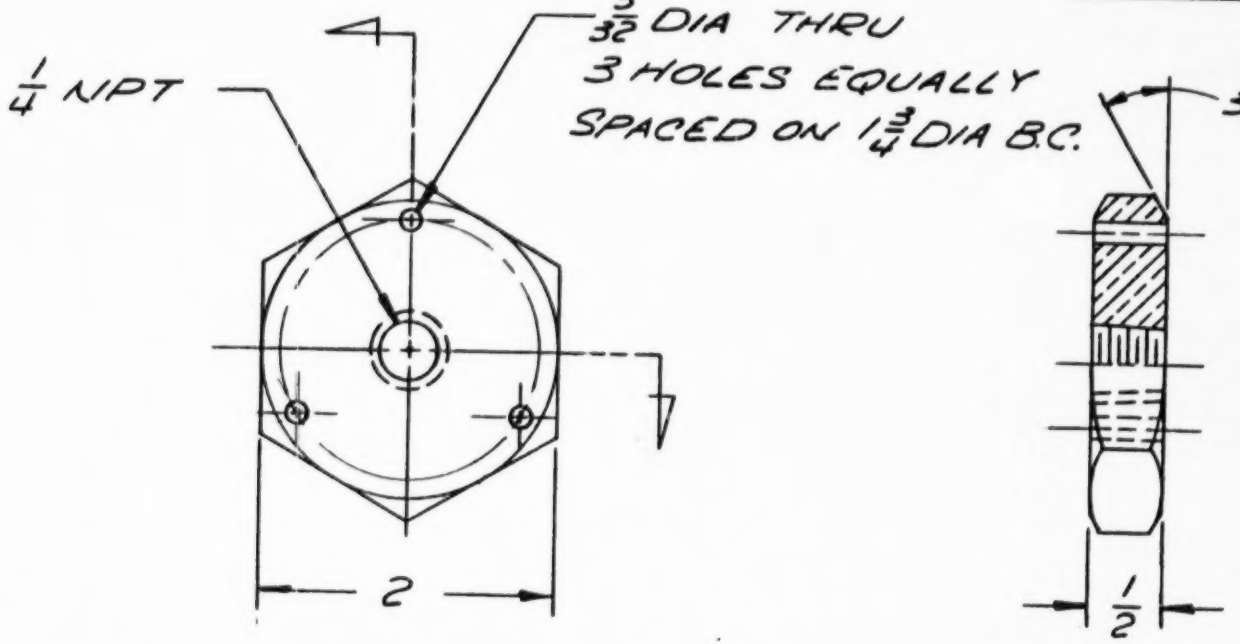
NOTE:

1. USE AEROQUIP SERVICEMASTER COUPLING PART Nº 55000-4005

2. COMPLETE AEROQUIP SERVICEMASTER JOINT PART Nº MJ 8750-4005 INCLUDES TWO FLANGES AND ONE COUPLING

12-20-79	AS LISTED	EXHAUST INLET ASS'Y
RJK	FLEXIBLE 1110C-0061	
TRI-MET		SK C-10005-A

SK-A-10007

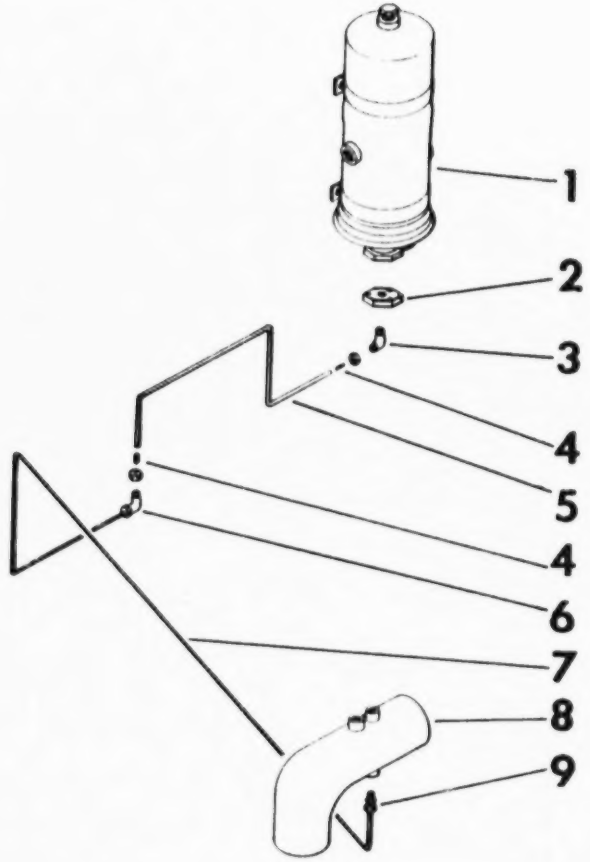


NOTE
INSTALL WITH 3
6-32 N.C. x 1/8 SCREWS

REVISED:

DATE DRAWN: DEC 8, 1979	MATERIAL: BRASS 2" HEX STOCK	TITLE: DRYER ADAPTER
DRAWN BY: RJK CHECKED BY:	WHERE USED: FLXIBLE 1110C-0061	
ALL DIMENSIONS IN INCHES GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-A-10007

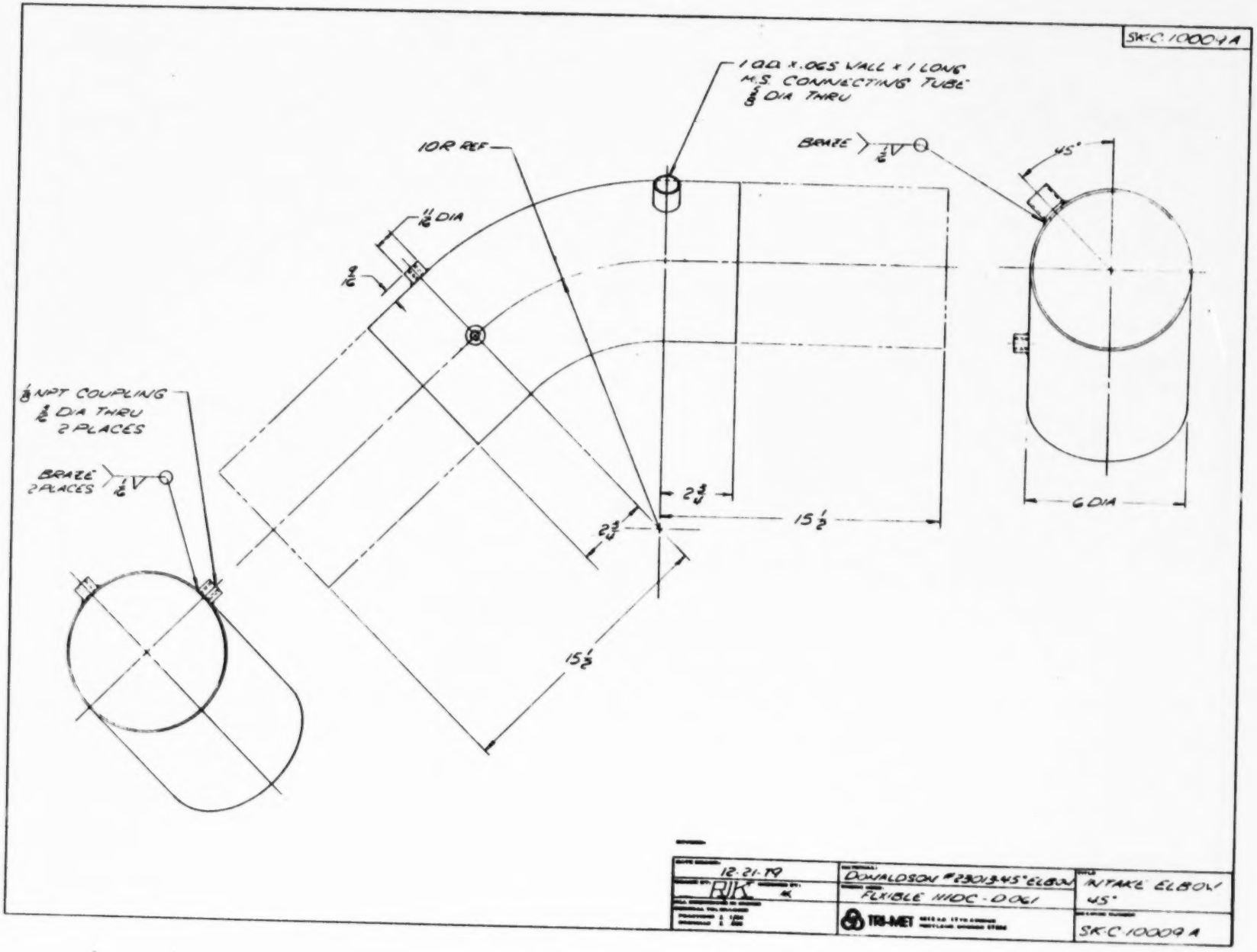
SK-A-10008-A



REF	PART NUMBER	DESCRIPTION
1	AD-2	Bendix Air Dryer
2	SK-A-10007	Adapter
3	269CA-6-4	Parker ¼" NPT Male Elbow
4	63PT-6-62	Parker Brass Insert
5	SAE J844B Type 3	3/8" OD Nylon Tube
6	165CA-6	Parker Union Elbow
7	SAE J844B Type 1	3/8" OD Copper Tube
8	SK-C-10005-2	90° Elbow
9	68CA-4-4	Parker ¼" NPT Male Connector

REVISED:

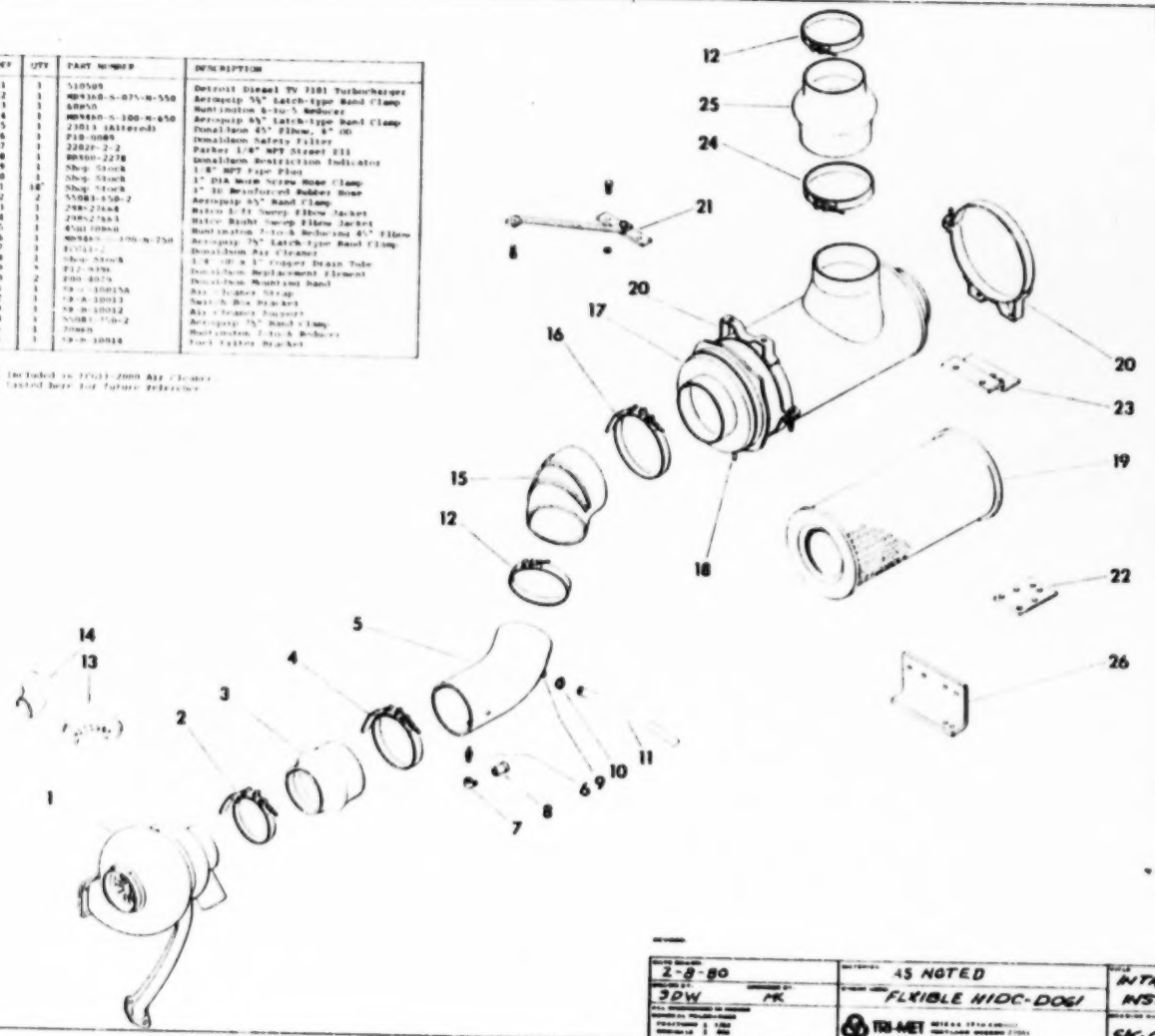
DATE DRAWN: JAN 4, 1980	MATERIAL: AS NOTED	TITLE: DRYER-AIRLINE INST.
DRAWN BY: SPS CHECKED BY:	WHERE USED: FLXIBLE 1111DC-D061	
ALL DIMENSIONS IN INCHES GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-A-10008-A


SK-C 10004 A
1.00 X .065 WALL X 1 LONG M.S. CONNECTING TUBE
5/8 DIA THRU
10R REF
BRAZE
45°
11/16 DIA
3/8
1/8 NPT COUPLING
5/8 DIA THRU
2 PLACES
BRAZE
2 PLACES
2 3/4
15 1/2
2 3/4
15 1/2
6 DIA
12-21-79
RJK
DONALDSON #2301 3-45° ELBOW
FLEXIBLE HOSE - 0061
TRI-MET
INTAKE ELBOW
45°
SK-C 10009 A

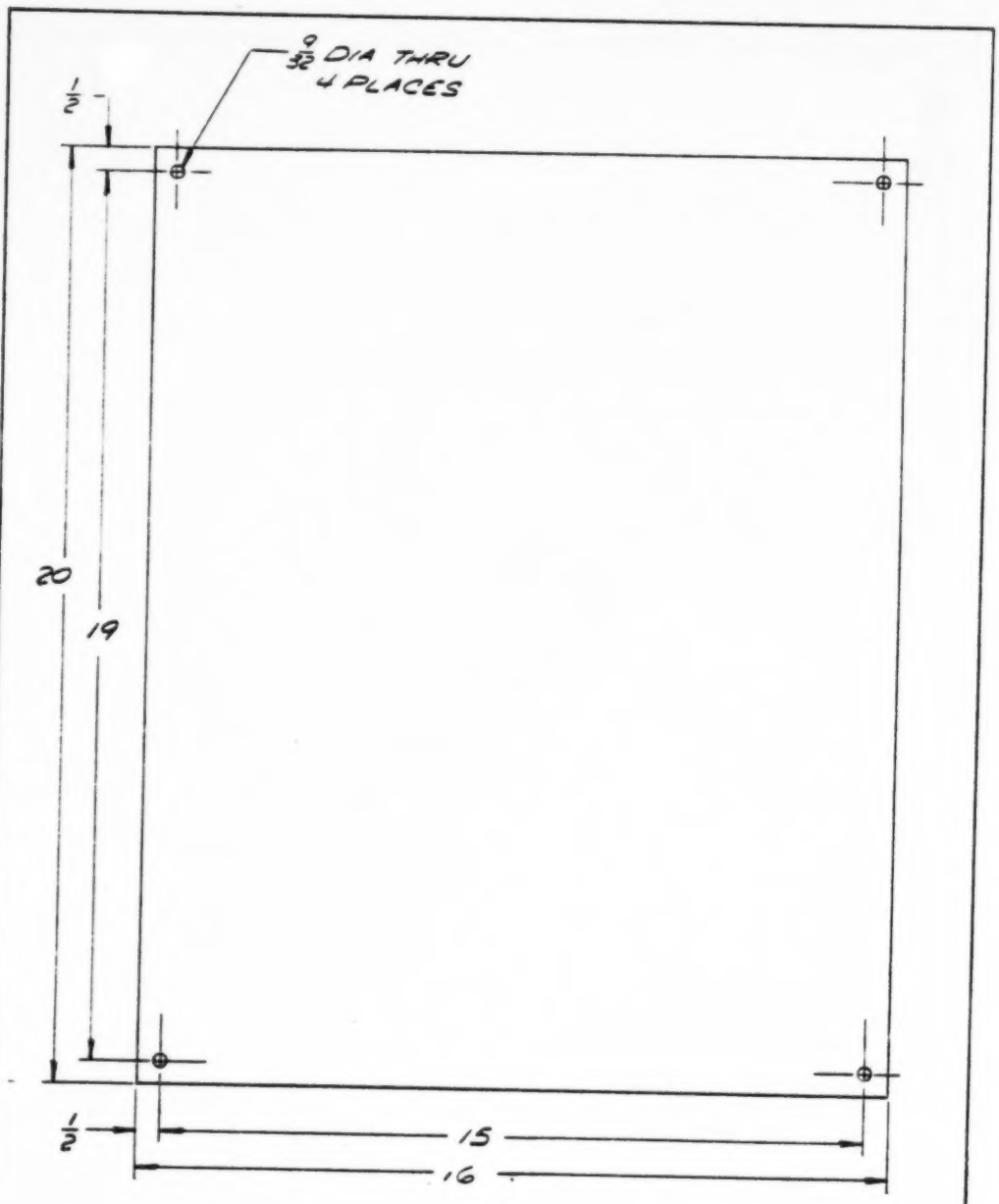
SK-C-10010-A

REF	QTY	PART NUMBER	DESCRIPTION
1	1	510509	Detroit Diesel TV 2101 Turbocharger
2	1	MB938-S-075-M-550	Aeroquip 5½" Latch-type Band Clamp
3	1	68050	Nuotmation 6-to-5 Reducer
4	1	MB9480-S-100-M-650	Aeroquip 6½" Latch-type Band Clamp
5	1	23013 (Altered)	Donaldson 45° Elbow, 6" OD
6	1	P10-0089	Donaldson Safety Filter
7	1	3202F-2-2	Parker 1/8" NPT Street 211
8	1	MB500-2278	Donaldson Restriction Indicator
9	1	Shop Stock	1/8" NPT Pipe Plug
10	1	Shop Stock	1" DIA Worm Screw Hose Clamp
11	18"	Shop Stock	1" ID Reinforced Rubber Hose
12	2	55083-550-2	Aeroquip 5½" Band Clamp
13	1	298-2744	Water 3-Ft Sweep Elbow Jacket
14	1	298-2743	Water Right Sweep Elbow Jacket
15	1	6381-0860	Nuotmation 5-to-4 Reducing 45° Elbow
16	1	MB9480-300-M-250	Aeroquip 7½" Latch-type Band Clamp
17	1	[illegible]	Donaldson Air Cleaner
18	1	Shop Stock	1/4" OD x 1" Copper Drain Tube
19	*	P12-4356	Donaldson Replacement Element
20	2	P00-4079	Donaldson Mounting Band
21	1	59-3-10015A	Air Heater Strap
22	1	59-3-10013	Small Air Bracket
23	1	59-3-10012	Air Cleaner Support
24	1	55083-750-2	Aeroquip 7½" Band Clamp
25	1	20869	Nuotmation 5-to-4 Reducer
26	1	59-3-10014	Fuel Filter Bracket

* Included in 23013-2000 Air Cleaner
Listed here for future reference

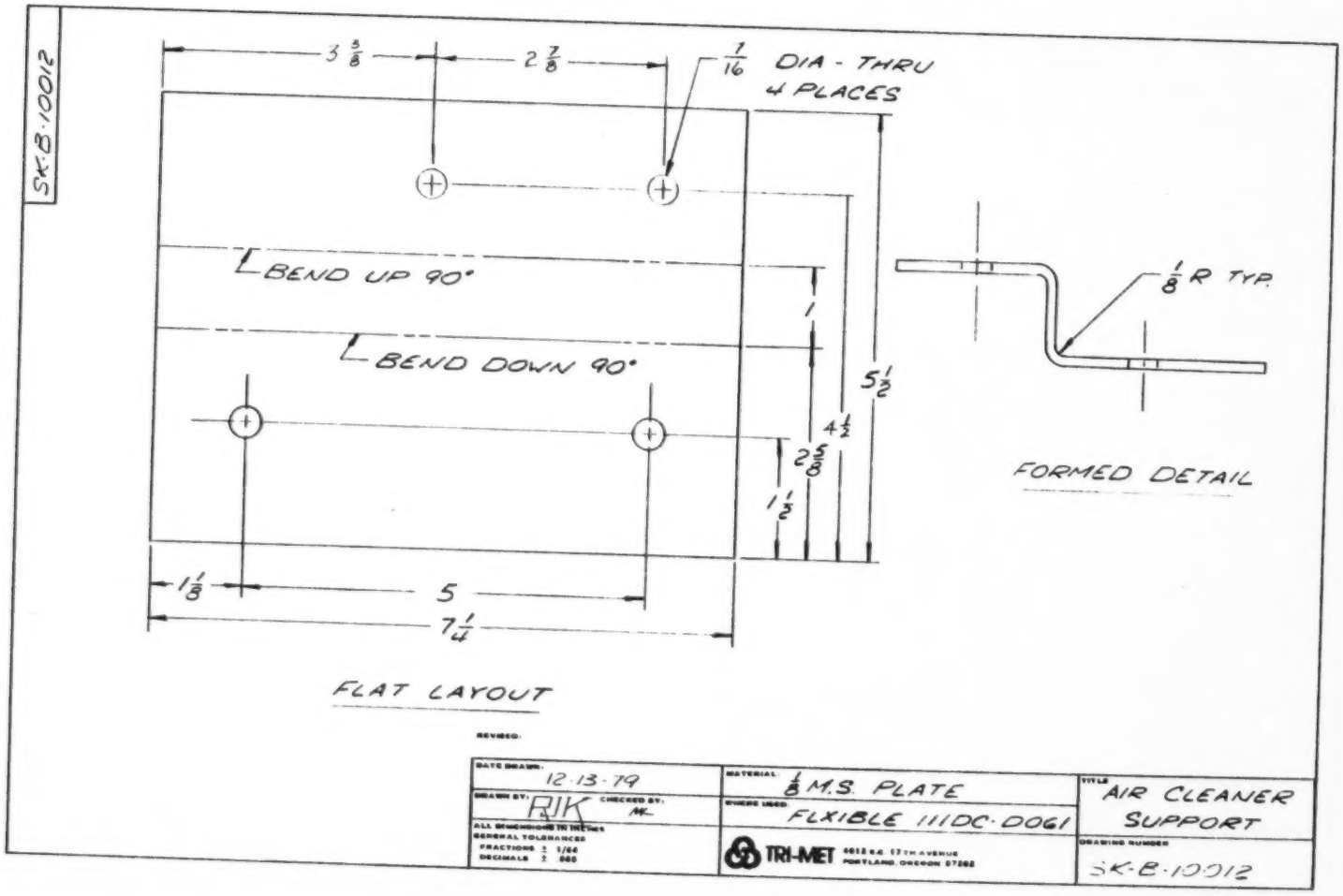


2-8-80	AS NOTED	INTAKE SYSTEM INSTALLATION
3DW MK	FLXIBLE HIDC-DOGI	
TRI-MET		SK-C-10010-A

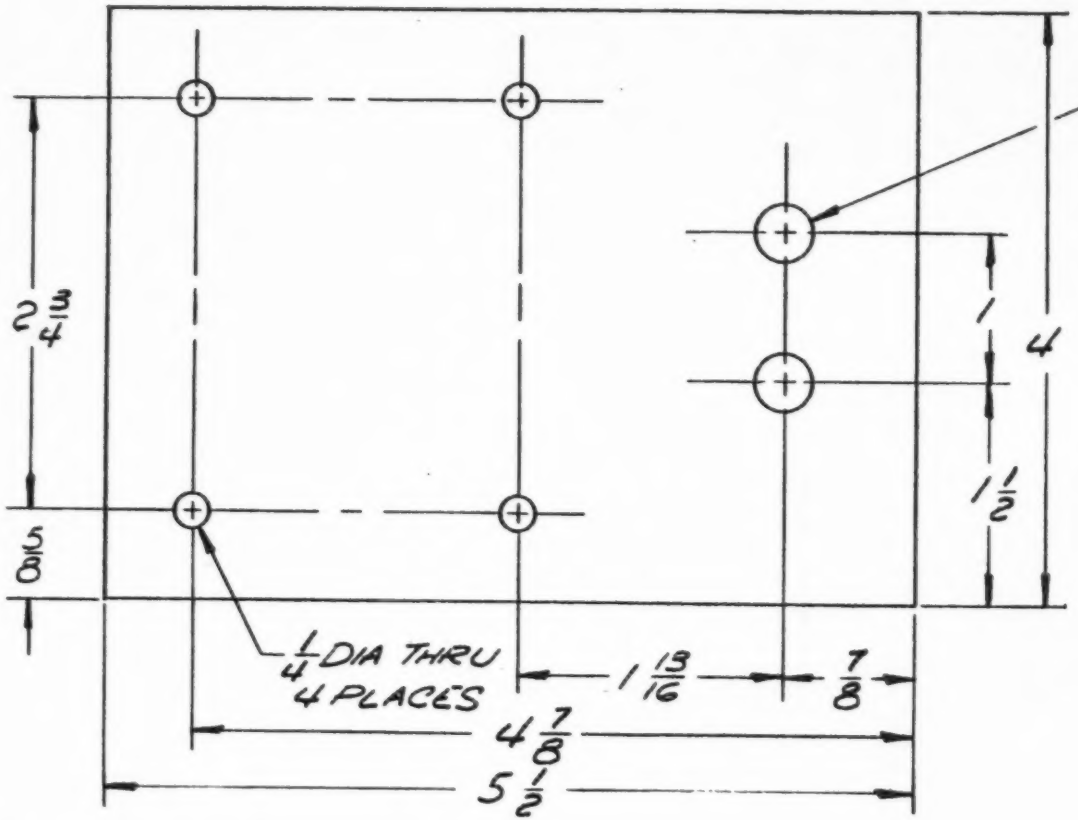


NOTE: PRIME BEFORE INST.

DATE DRAWN: DEC 9 1979	MATERIAL: 1/8 M.S. PLATE	TITLE: FIREWALL BLANK
DRAWN BY: RJK CHECKED BY:	STOCK NO.: FLXIBLE 1110C-0061	
ALL DIMENSIONS IN INCHES. GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 6012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-B-10011

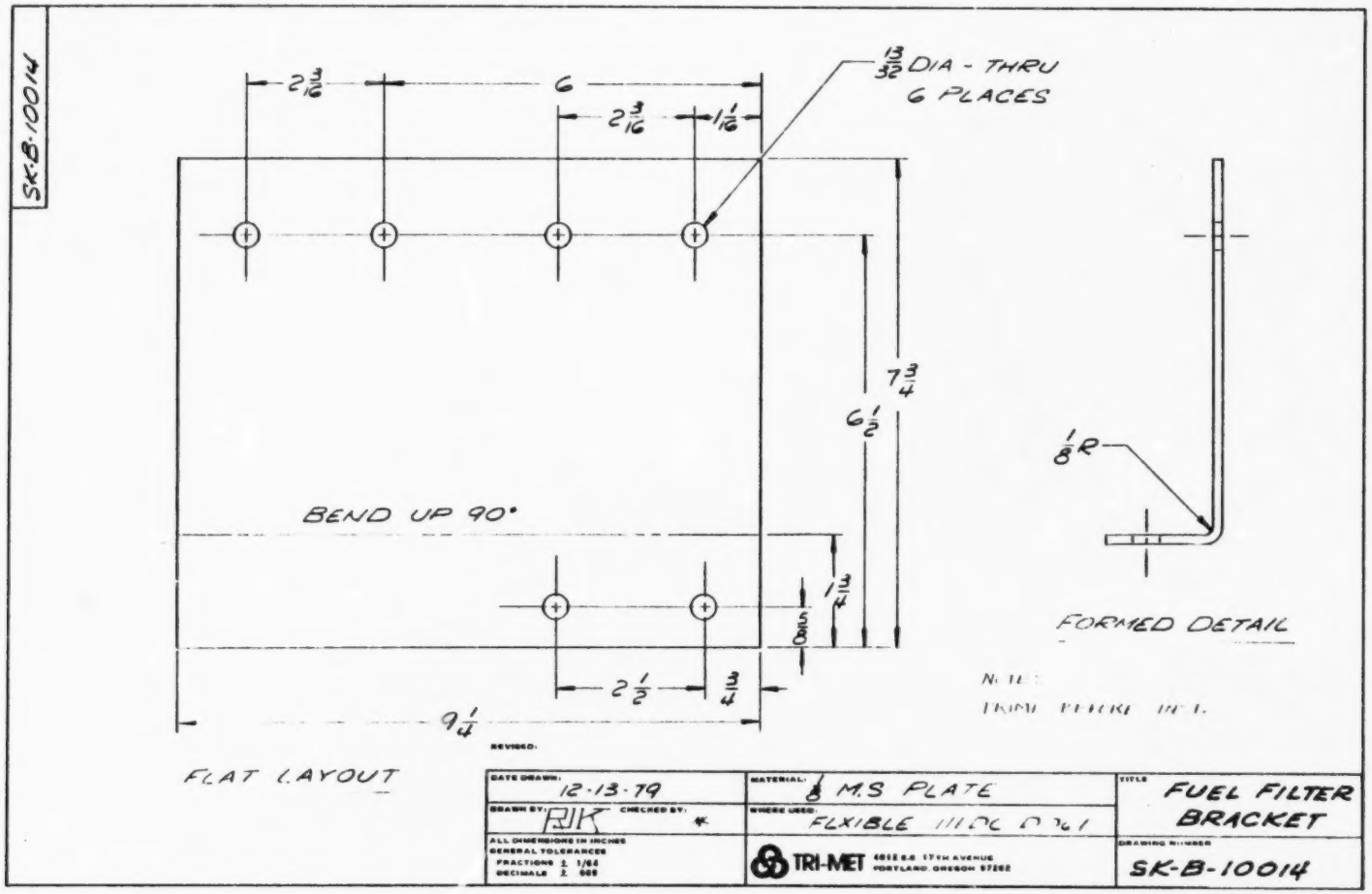

SK-B-10012
3 3/8
2 7/8
1/16 DIA - THRU 4 PLACES
BEND UP 90°
BEND DOWN 90°
1
5 1/2
4 1/2
2 5/8
1 1/2
1 1/8
5
7 1/4
FLAT LAYOUT
1/8 R TYP.
FORMED DETAIL
REVISED:
DATE DRAWN: 12-13-79
DRAWN BY: RJK
CHECKED BY: MK
ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005
MATERIAL: 1/8 M.S. PLATE
WHERE USED: FLXIBLE 111DC-0061
TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202
TITLE: AIR CLEANER SUPPORT
DRAWING NUMBER: SK-B-10012

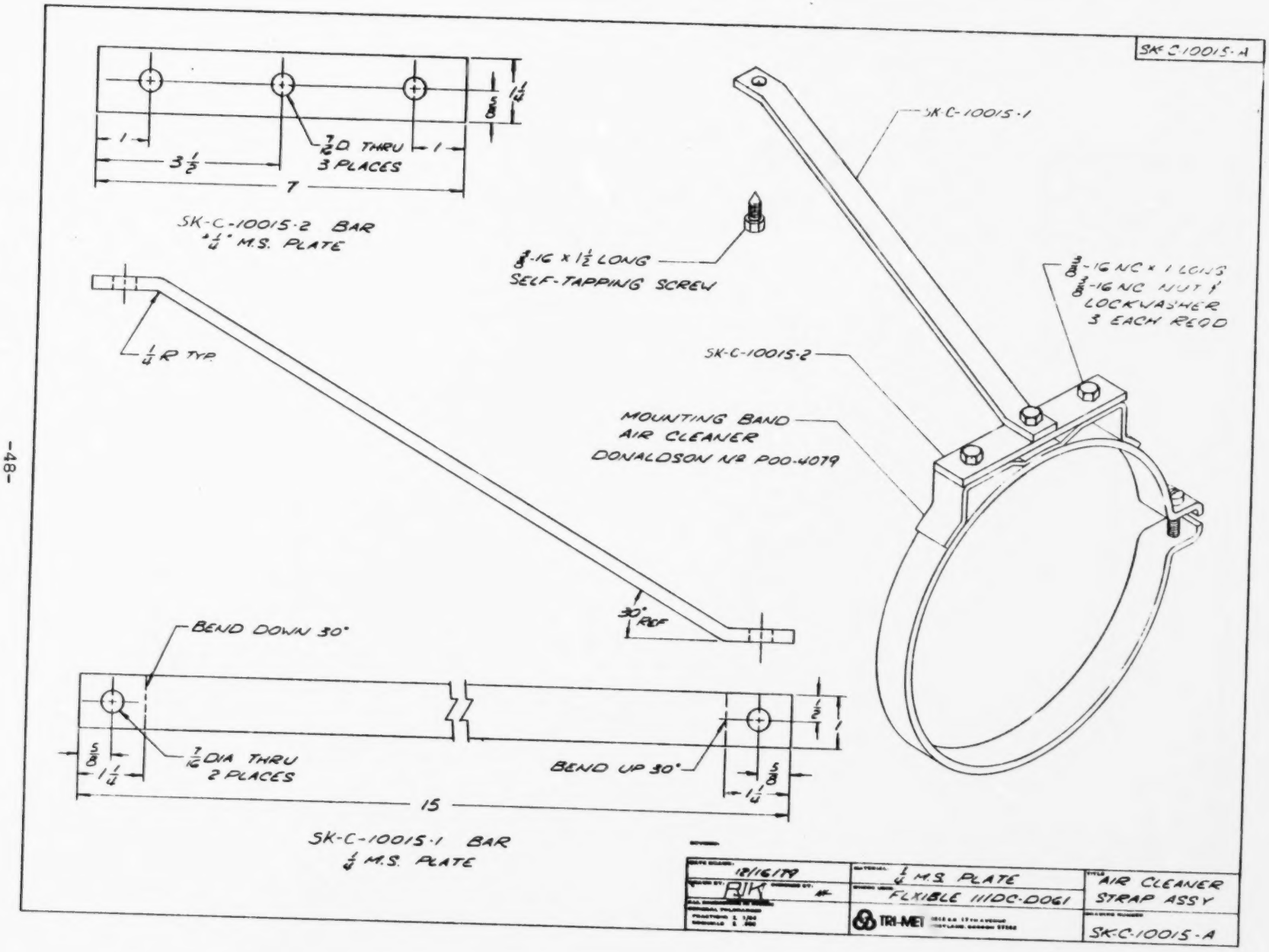
SK-A-10003

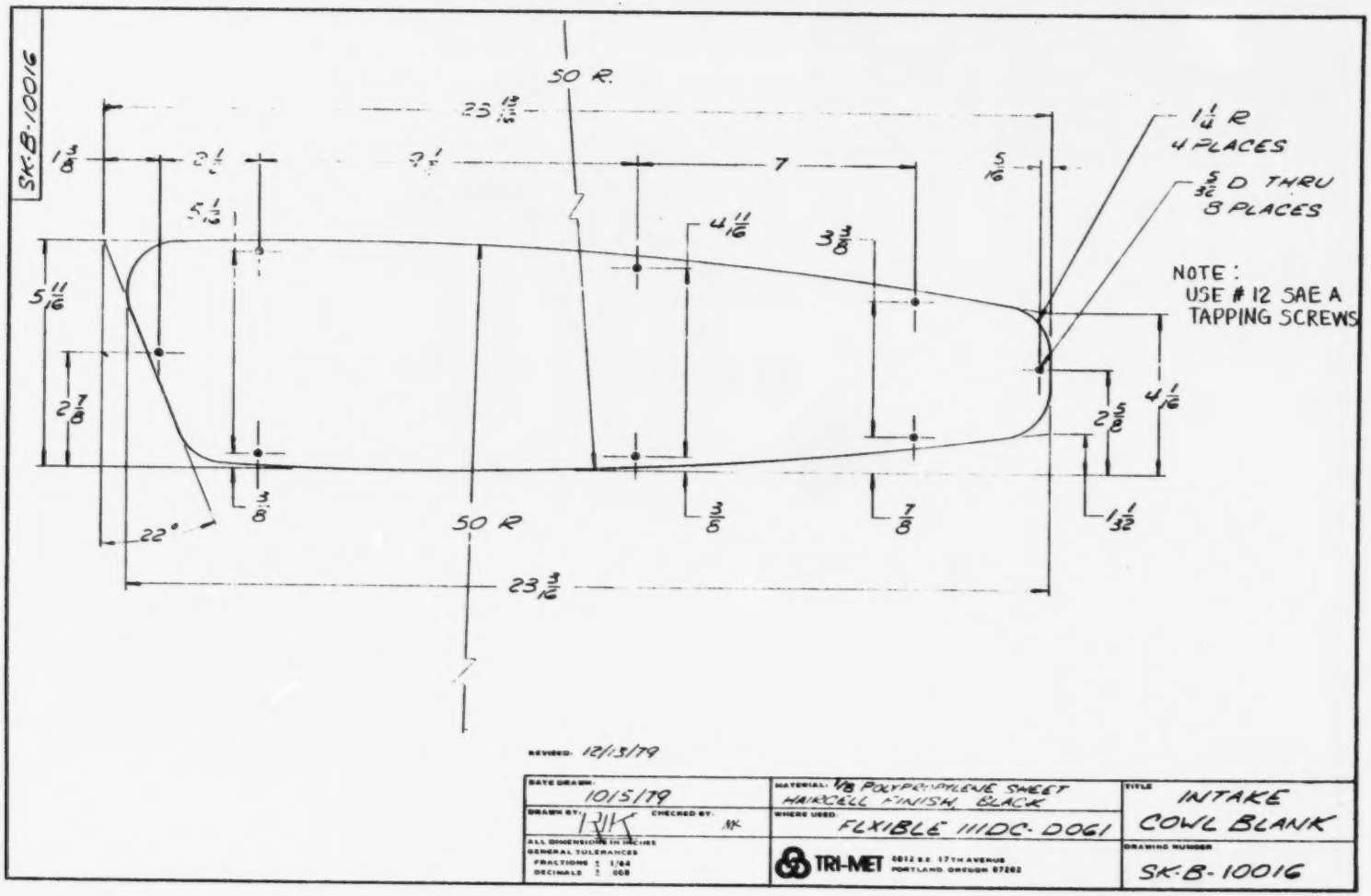


REVISED:

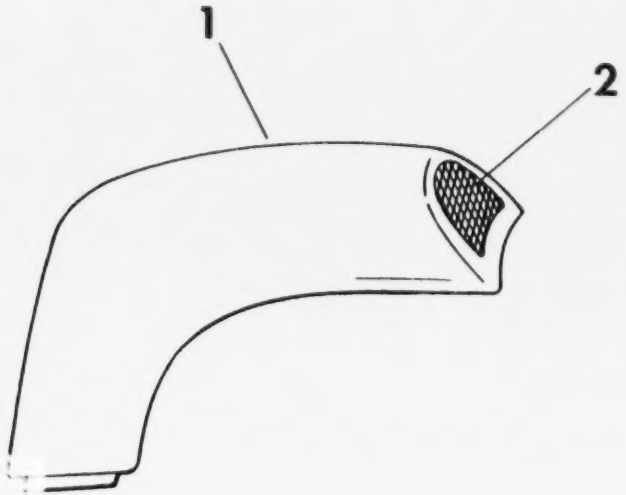
DATE DRAWN: 12/10/79	MATERIAL: 1/8 M.S. PLATE	TITLE: SWITCH BOX BRACKET
DRAWN BY: RJK CHECKED BY:	WHERE USED: FLXIBLE 1111DC-0061	
ALL DIMENSIONS IN INCHES GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-A-10013


SK-B-10014
2 3/16
6
2 3/16
1 1/16
13/32 DIA - THRU
6 PLACES
7 3/4
6 1/2
1/8 R
BEND UP 90°
1 3/4
2 1/2
3/4
9 1/4
FORMED DETAIL
FLAT LAYOUT
DATE DRAWN: 12-13-79
DRAWN BY: RJK
CHECKED BY:
MATERIAL: 1/8 M.S PLATE
WHERE USED: FLXIBLE HOSE ASSY
TITLE: FUEL FILTER BRACKET
ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005
TRI-MET 6012 S.E. 17TH AVENUE PORTLAND, OREGON 97202
DRAWING NUMBER: SK-B-10014


SK-C-10015-A
SK-C-10015-1
SK-C-10015-2
MOUNTING BAND
AIR CLEANER
DONALDSON NR P00-4079
3/8-16 NC x 1 LONG
3/8-16 NC NUT &
LOCKWASHER
3 EACH END
3/8-16 x 1 1/2 LONG
SELF-TAPPING SCREW
1/4 R TYP
30° REF
BEND DOWN 30°
BEND UP 30°
7/16 DIA THRU
2 PLACES
7/16 DIA THRU
3 PLACES
15
7
SK-C-10015-2 BAR
1/4" M.S. PLATE
SK-C-10015-1 BAR
1/4 M.S. PLATE
12/16/79
RJK
1/4 M.S. PLATE
FLXIBLE 1111DC-D061
TRI-MET
AIR CLEANER
STRAP ASSY
SK-C-10015-A


SK-B-10016
50 R.
25 13/16
1 3/8
2 1/2
7 1/2
7
5/16
1 1/4 R
4 PLACES
5/32 D THRU
8 PLACES
5 1/2
4 11/16
3 3/8
5 11/16
NOTE:
USE # 12 SAE A
TAPPING SCREWS
2 7/8
4 1/16
2 5/8
3/8
22°
50 R
3/8
7/8
1 1/32
23 3/16
REVISED: 12/13/79
DATE DRAWN: 10/5/79
DRAWN BY: RJK
CHECKED BY: MK
ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005
MATERIAL: 1/8 POLYPROPYLENE SHEET
HAIRCELL FINISH, BLACK
WHERE USED: FLXIBLE 1111DC-0061
TRI-MET 6012 S.E. 17TH AVENUE PORTLAND, OREGON 97202
TITLE: INTAKE COWL BLANK
DRAWING NUMBER: SK-B-10016

SK-A-10017-A



REF	PART NO.	MATERIAL
2	SK-A-10017-2	SS WIRE SCRN
1	SK-A-10017-1	FIBERGLASS

REVISED:

DATE DRAWN: JAN 7, 1979

DRAWN BY: SPS CHECKED BY:

ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005

MATERIAL: AS NOTED

WHERE USED: FLXIBLE 111DC-D061

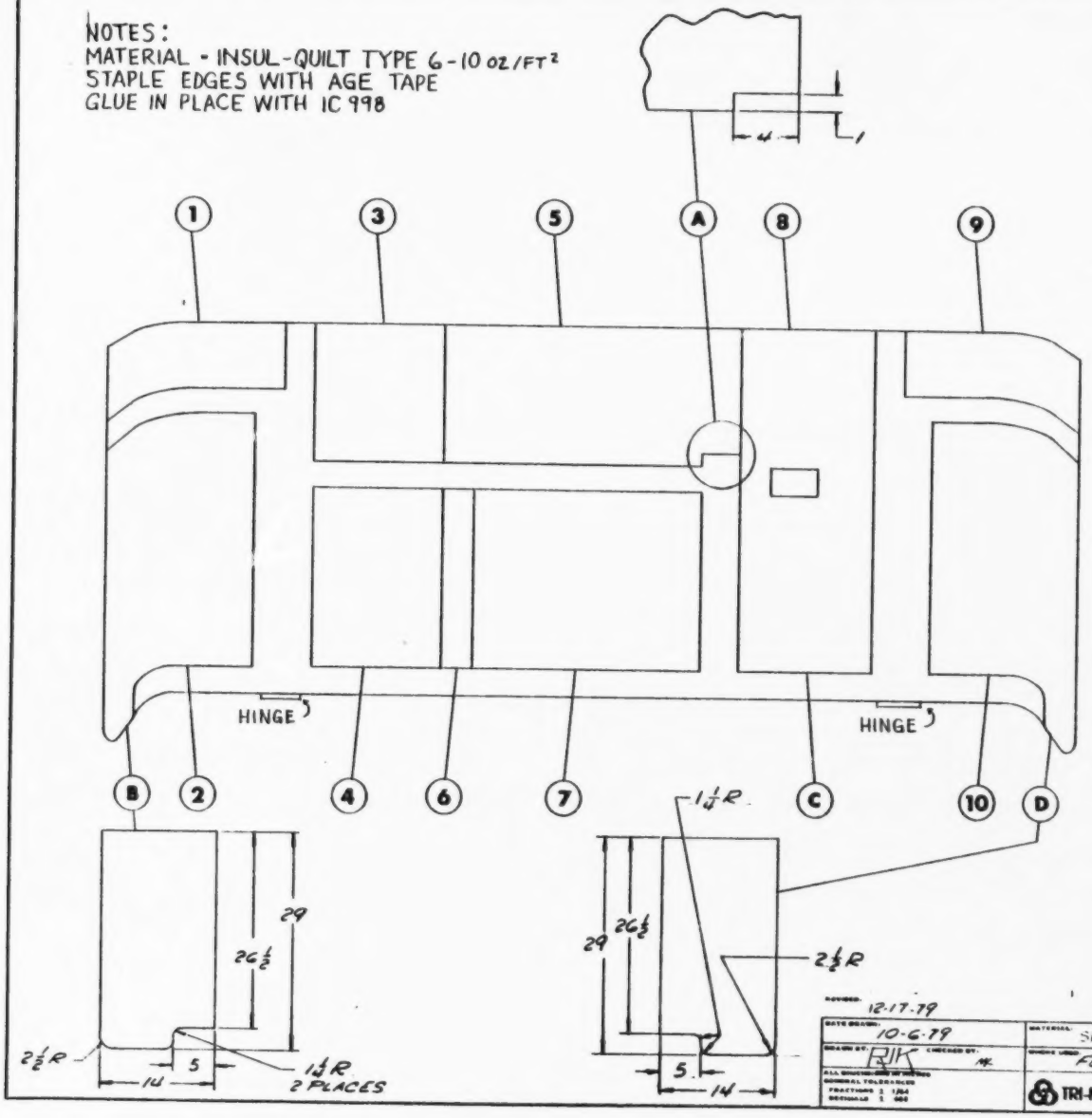
TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202

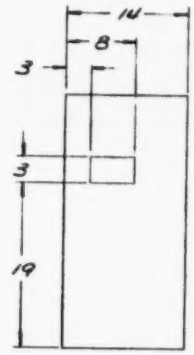
TITLE: HOLLOWAY SNORKLE

DRAWING NUMBER: SK-A-10017-A

SK-C-10018A

NOTES:
MATERIAL - INSUL-QUILT TYPE 6 - 10 OZ/FT²
STAPLE EDGES WITH AGE TAPE
GLUE IN PLACE WITH IC 998

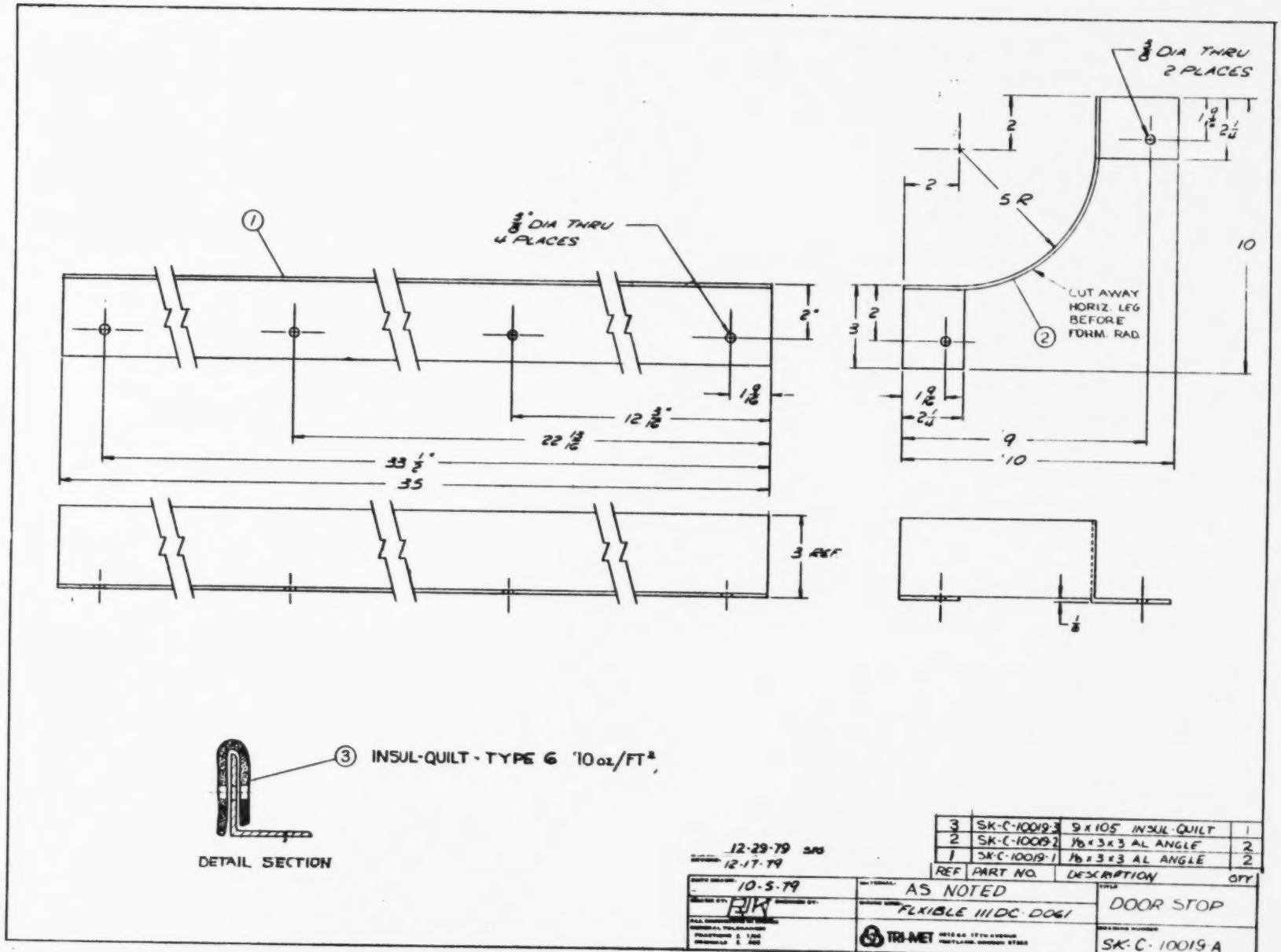




DETAIL C

DASH	PART NO.	SIZE
1	SK-C-10018-1	7 x 20
2	SK-C-10018-2	29 x 14
3	SK-C-10018-3	14 x 14
4	SK-C-10018-4	19½ x 14
5	SK-C-10018-5	14 x 30½
6	SK-C-10018-6	19½ x 3
7	SK-C-10018-7	19½ x 24
8	SK-C-10018-8	35 x 13½
9	SK-C-10018-9	7 x 20
10	SK-C-10018-10	29 x 14

REVISED 12.17.79
DATE DRAWN 10-6-79
DRAWN BY RJK
CHECKED BY
ALL DIMENSIONS ARE IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS ± .005
MATERIAL SEE NOTES
FINISH USED FLEXIBLE INSULQUILT
TRI-MET 4012 S.E. 17TH AVENUE PORTLAND OREGON 97202
TITLE REAR DOOR PADDING
DRAWING NUMBER SK-C-10018A



REF	PART NO.	DESCRIPTION	QTY
3	SK-C-10019-3	9 x 105 INSUL-QUILT	1
2	SK-C-10019-2	1/8 x 3 x 3 AL ANGLE	2
1	SK-C-10019-1	1/8 x 3 x 3 AL ANGLE	2

12-29-79 SAS
12-17-79

10-5-79 RJK

AS NOTED

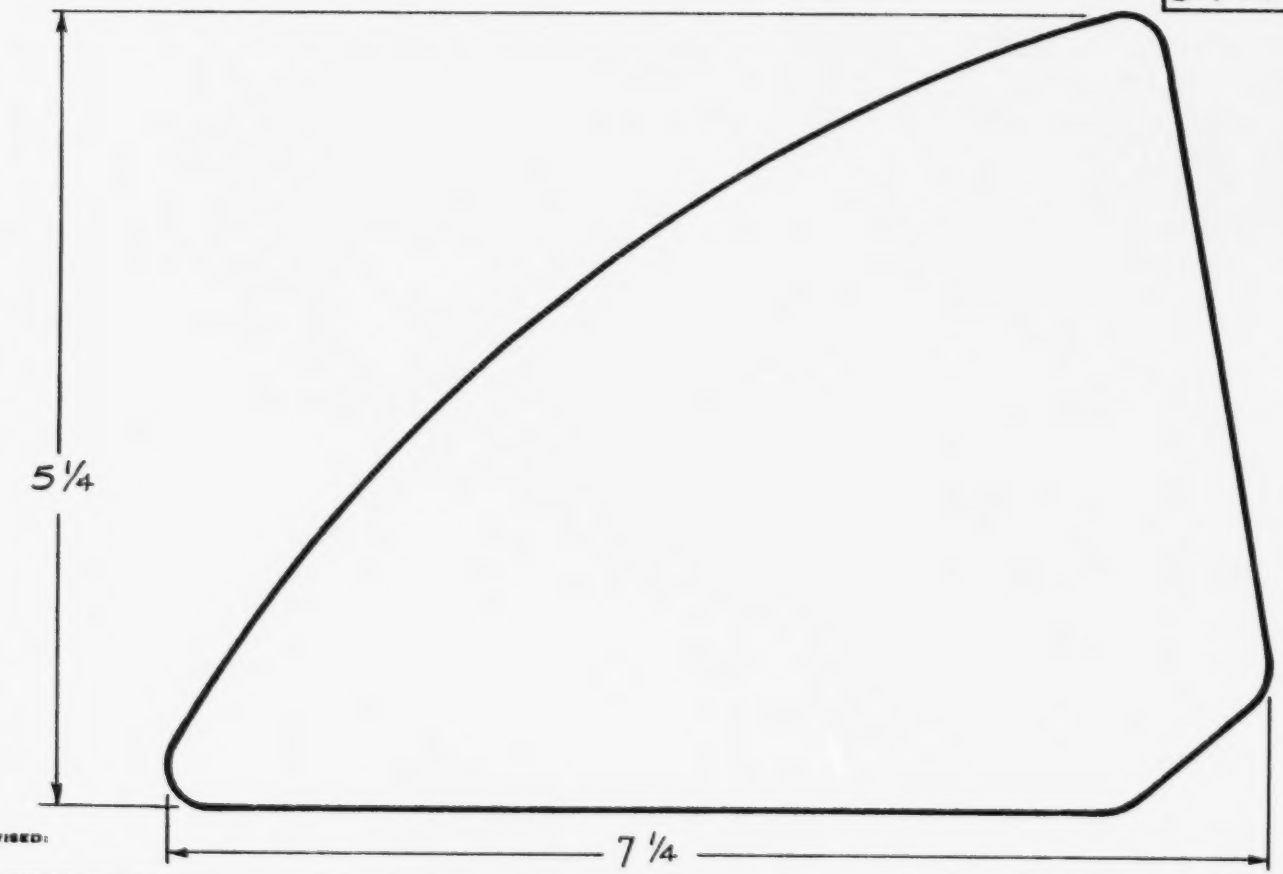
FLXIBLE 111DC-0061

TRI-MET

DOOR STOP

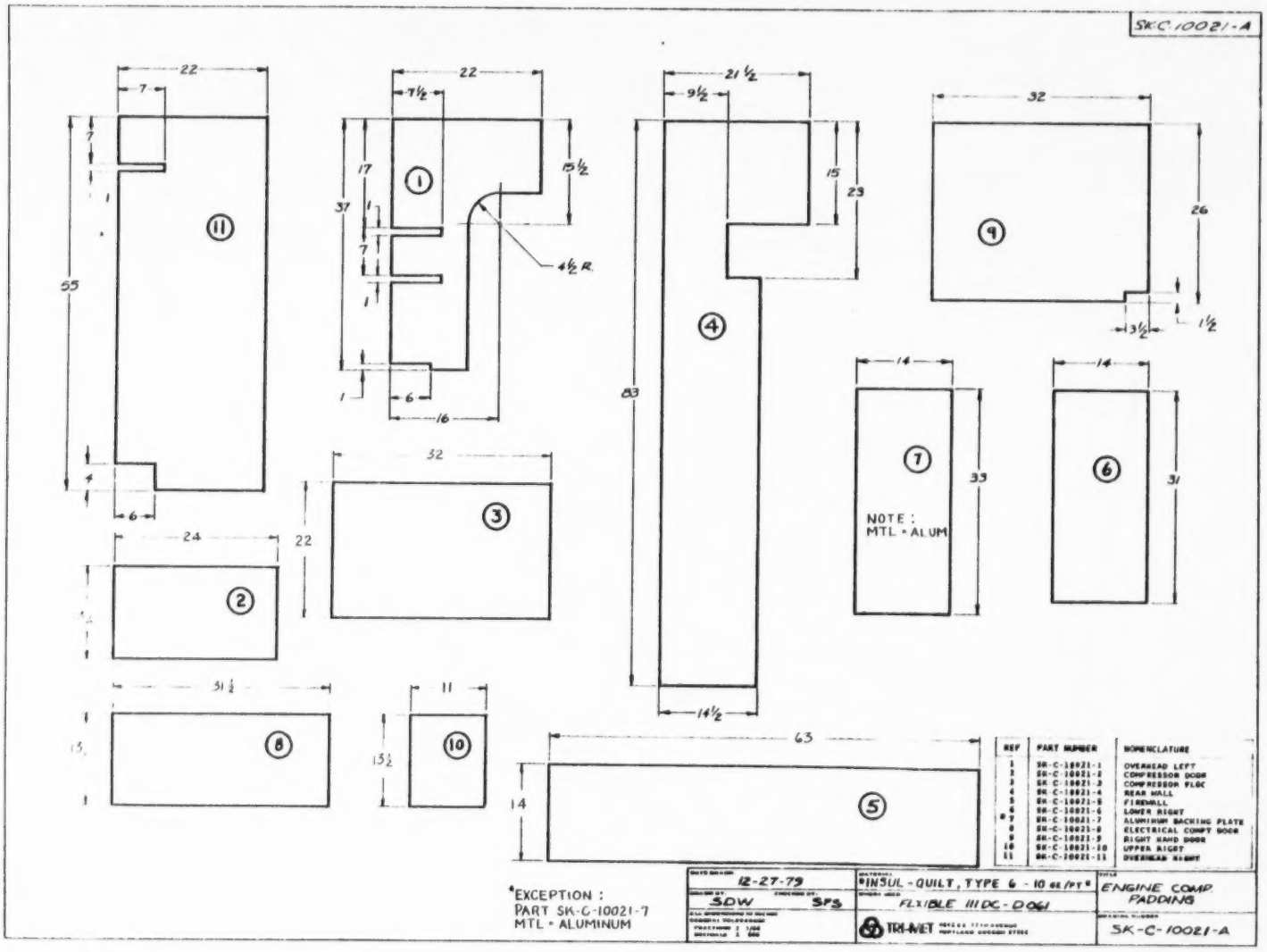
SK-C-10019 A

SK-A-10020



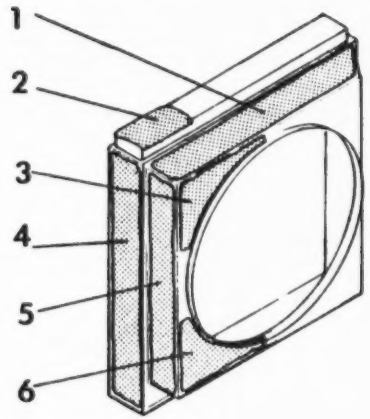
REVISED:

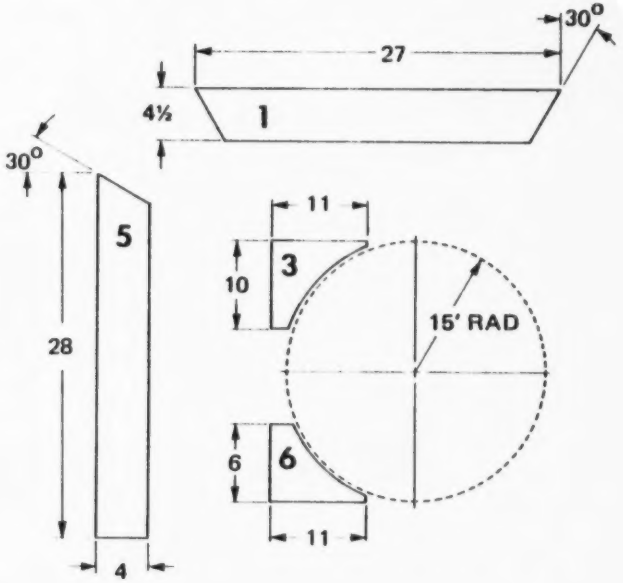
DATE DRAWN: 12-8-79	MATERIAL: N/A	TITLE: SNORKLE TEMPLATE
DRAWN BY: SDW CHECKED BY: SPS	WHERE USED: FLXIBLE 111DC-D061	
ALL DIMENSIONS IN INCHES GENERAL TOLERANCES FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202	DRAWING NUMBER: SK-A-10020



REF	PART NUMBER	NOMENCLATURE
1	SK-C-10021-1	OVERHEAD LEFT
2	SK-C-10021-2	COMPRESSOR DOOR
3	SK-C-10021-3	COMPRESSOR FLOC
4	SK-C-10021-4	REAR WALL
5	SK-C-10021-5	FIREWALL
6	SK-C-10021-6	LOWER RIGHT
*7	SK-C-10021-7	ALUMINUM BACKING PLATE
8	SK-C-10021-8	ELECTRICAL COMPT DOOR
9	SK-C-10021-9	RIGHT HAND DOOR
10	SK-C-10021-10	UPPER RIGHT
11	SK-C-10021-11	OVERHEAD RIGHT

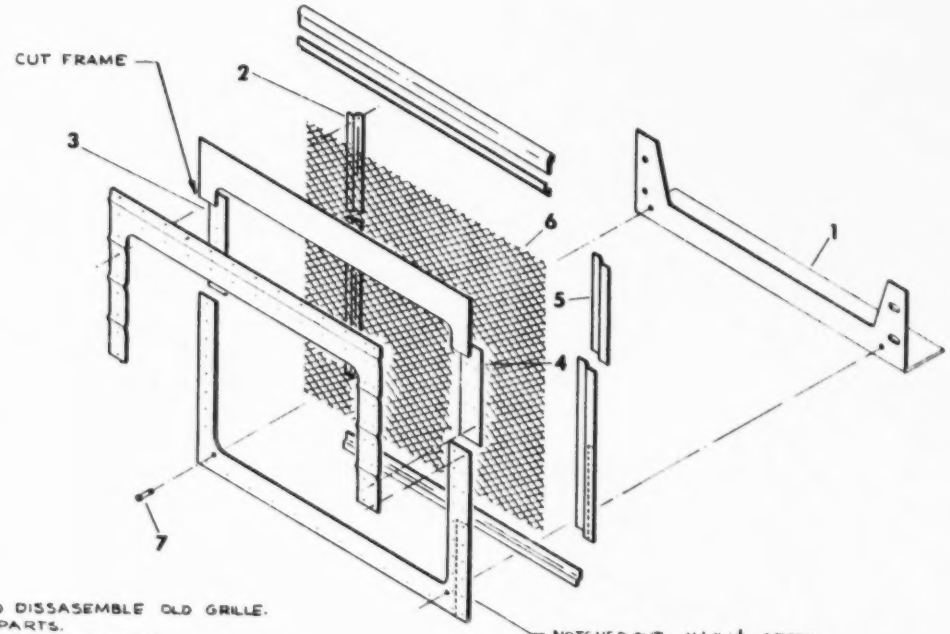
SK-C-10022-A





REF	PART NUMBER	OVERALL DIMENSIONS
1	SK-B-10022-1	4½ x 27
2	SK-B-10022-2	6 x 9
3	SK-B-10022-3	10 x 11
4	SK-B-10022-4	6 x 25
5	SK-B-10022-5	4 x 28
6	SK-B-10022-6	6 x 11

DATE DESIGN: 2/11/80	INSUL. QUILT. TYPE 6-10 oz/FT²	TYPE: RADIATOR PADDING
DESIGN BY: DRS CHECKED BY:	FLEXIBLE 111DC-0061	
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED FRACTIONS ± 1/64 DECIMALS ± .005	TRI-MET 4012 S.E. 17th AVENUE PORTLAND, OREGON 97202	SK-C-10022-A

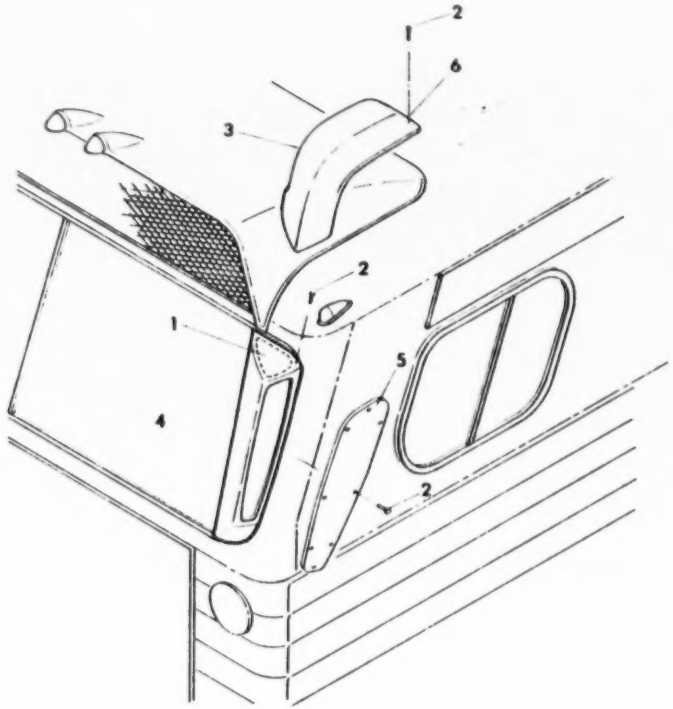


STEPS:
1. REMOVE RIVETS AND DISSASEMBLE OLD GRILLE.
2. FABRICATE NEW PARTS.
3. CUT FRAME 6" BELOW TOP EDGE.
4. REASSEMBLE W/RIVETS, LINE DRILL AS NEEDED.
5. CUT NOTCH IN LOWER R.H CORNER.
6. INSTALL GRILLE AND LINE DRILL THRU AND INTO GRILLE SUPPORT (SK-B-10025). TAP ¼" - 20 NC

REF	PART NO	DESCRIPTION	Q'TY
7	SK-C-10023-6	1⅛ X ⅛ - 20 NC	2
6	SK-C-10023-5	1 X 2 DIAMOND MS EXP MESH 3⅛ X 32⅛	1
5	SK-C-10023-4	16 GA AL 10⅛ X 3½	1
4	SK-C-10023-3	16 GA AL 11 X 3½	1
3	SK-C-10023-2	16 GA AL 11 X 2	1
2	SK-C-10023-1	16 GA AL 10⅛ X 2	1
1	SK-B-10025	GRILLE SUPPORT	1

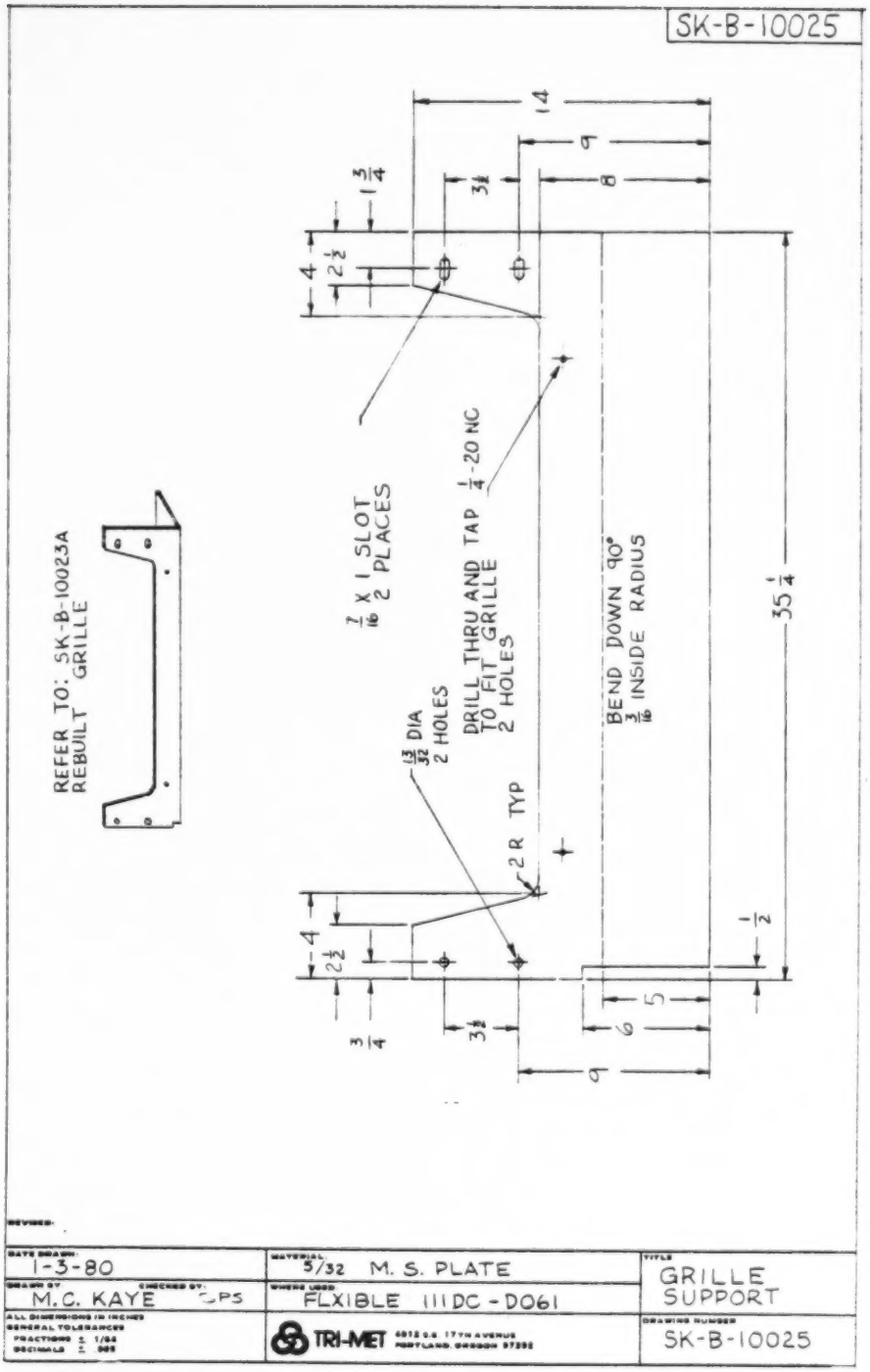
1/4/80	AS NOTED	REBUILT GRILLE
SP3 MK	FLEXIBLE HIDC-DOG1	
	TRI-MET	SK-C-10023-A

SK-C-0024-A



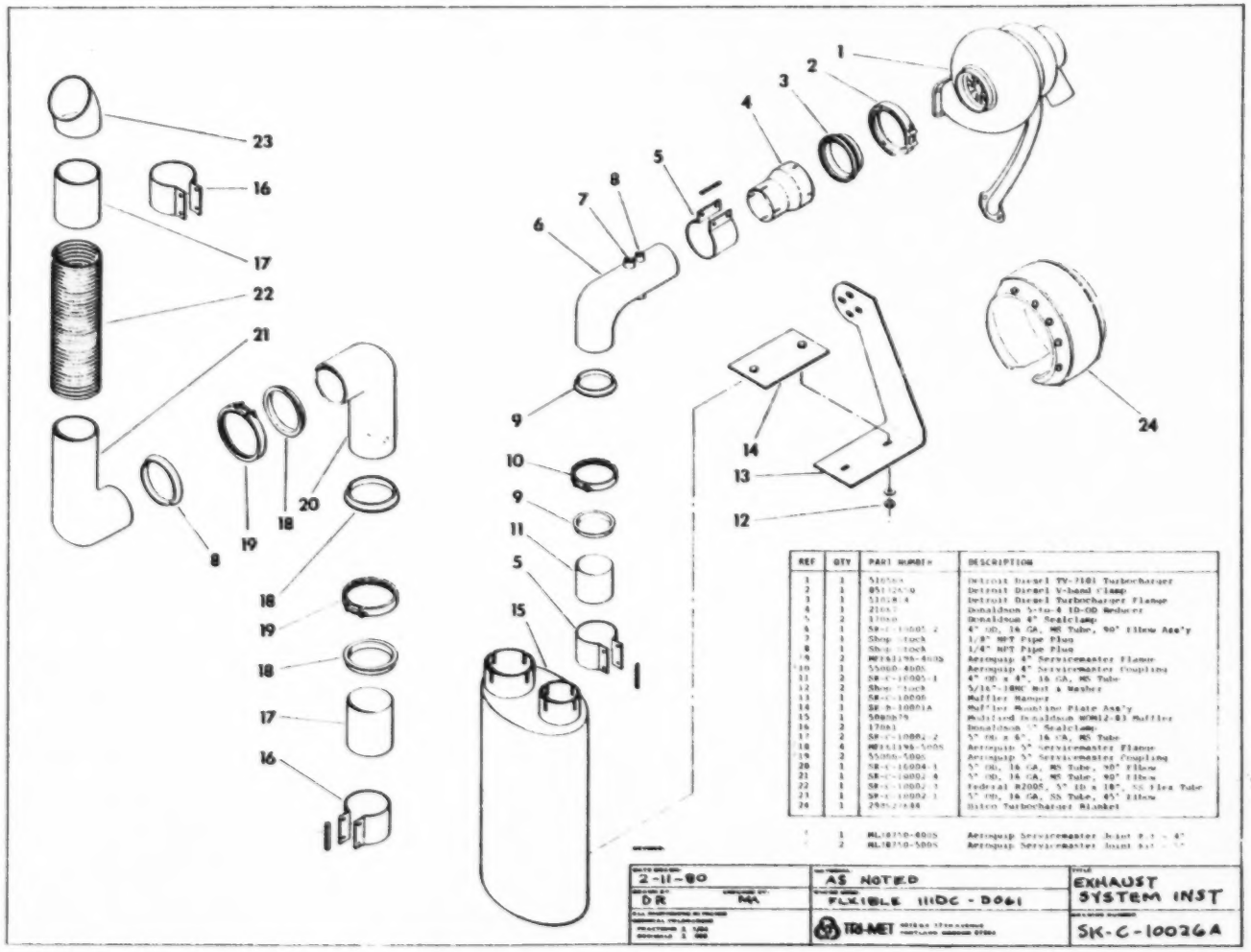
REF	PART NUMBER	NOMENCLATURE
1	SP-A-10020	SNORKEL TEMPLATE
2		SHEET METAL SCREW
3	SP-A-10017A	MOLDED SNORKEL
4		EXISTING INTAKE DUCT
5	SP-A-10016	INTAKE DUCT BLANK
6	SP-A-10017-1	SS WIRE SCREEN

1-29-79	N/A	SNORKLE INSTALLATION
SPS	FLEXIBLE HOSE ASSY	
TRI-MET		SK-C-0024-A


SK-B-10025
REFER TO: SK-B-10023A
REBUILT GRILLE
7/16 X 1 SLOT
2 PLACES
DRILL THRU AND TAP 1/4-20 NC
TO FIT GRILLE
2 HOLES
13/32 DIA
2 HOLES
2 R TYP
BEND DOWN 90°
3/16 INSIDE RADIUS
35 1/4
14
9
8
1 3/4
3 1/4
4
2 1/2
1/2
5
6
9
3/4
3 1/4
4
2 1/2
REVISED
DATE DRAWN 1-3-80
DRAWN BY M.C. KAYE
CHECKED BY PS
ALL DIMENSIONS IN INCHES
GENERAL TOLERANCES
FRACTIONS ± 1/64
DECIMALS .XX ± .02
MATERIAL 5/32 M. S. PLATE
WHERE USED FLXIBLE 111DC-D061
TRI-MET 4012 S.E. 17TH AVENUE PORTLAND, OREGON 97202
TITLE GRILLE SUPPORT
DRAWING NUMBER SK-B-10025

330 Copies

59/60



REF	QTY	PART NUMBER	DESCRIPTION
1	1	510564	Detroit Diesel TV-7101 Turbocharger
2	1	0511249	Detroit Diesel V-band Clamp
3	1	51018-4	Detroit Diesel Turbocharger Flange
4	1	21083	Donaldson 5-to-4 ID-OD Reducer
5	2	11060	Donaldson 4" Sealclamp
6	1	SK-C-10005-2	4" OD, 16 GA, MS Tube, 90° Elbow Ass'y
7	1	Shop Stock	1/8" NPT Pipe Plug
8	1	Shop Stock	1/4" NPT Pipe Plug
9	2	MS21156-4005	Aeroquip 4" Servicemaster Flange
10	1	55080-4005	Aeroquip 4" Servicemaster Coupling
11	2	SK-C-10005-1	4" OD x 4", 16 GA, MS Tube
12	2	Shop Stock	5/16"-18NC Nut & Washer
13	1	SK-C-10006	Muffler Hanger
14	1	SK-D-10001A	Muffler Mounting Plate Assy
15	1	5000679	Modified Donaldson WSM12-83 Muffler
16	2	17061	Donaldson 5" Sealclamp
17	2	SK-C-10002-2	5" OD x 6", 16 GA, MS Tube
18	4	MS21156-5005	Aeroquip 5" Servicemaster Flange
19	2	55080-5005	Aeroquip 5" Servicemaster Coupling
20	1	SK-C-10004-1	5" OD, 16 GA, MS Tube, 90° Elbow
21	1	SK-C-10002-4	5" OD, 16 GA, MS Tube, 90° Elbow
22	1	SK-C-10002-3	Federal R2005, 5" ID x 18", SS Flex Tube
23	1	SK-C-10002-1	5" OD, 16 GA, SS Tube, 45° Elbow
24	1	2585/2484	Bifco Turbocharger Blanket
*	1	ML10350-4005	Aeroquip Servicemaster Joint Kit - 4"
*	2	ML10350-5005	Aeroquip Servicemaster Joint Kit - 5"

2-11-80	AS NOTED	EXHAUST SYSTEM INST
DR MA	FLEXIBLE IIIDC - D061	
	TRI-MET	SK-C-10026A

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